Physical and Chemical Data from the Canadian Arctic Archipelago, August 23 to September 8, 1999

F. McLaughlin, E. Carmack, M. O'Brien, G. Arfeuille, J. Barwell-Clarke, N. Sutherland, D. Tuele, G. Gatien, H. Melling, S. Zimmermann and M. Corkum

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PHYSICAL AND CHEMICAL DATA FROM THE CANADIAN ARCTIC ARCHIPELAGO, AUGUST 23 TO SEPTEMBER 8, 1999

by

F. McLaughlin, E. Carmack, M. O'Brien, G. Arfeuille, J. Barwell-Clarke,
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ABSTRACT

McLaughlin, F., Carmack, E., O'Brien, M., Arfeuille, G., Barwell-Clarke, J., Sutherland, N., Tuele, D., Gatien, G., Melling, H., Zimmermann, S. and Corkum, M. 2009. Physical and Chemical Data from the Canadian Arctic Archipelago, August 23 to September 8, 1999. *Can. Data Rep. Hydrogr. Ocean Sci.* 179: vii + 140 p.

The physical and chemical water properties of the Canadian Arctic Archipelago were measured during an expedition aboard the *CCGS Sir Wilfrid Laurier* from August 23 to September 8, 1999 (Institute of Ocean Sciences Mission Number 1999-24). The objective of this cruise was to study freshwater transport and the flux of carbon and nutrients in Amundsen Gulf and Peel Sound, two of the three main sub-basins of the Canadian Arctic Archipelago. Oceanographic data reported include conductivity-temperature-depth (CTD), salinity, dissolved oxygen, orthophosphate, silicate, nitrate (plus nitrite), chlorofluorocarbons and carbon tetrachloride, and oxygen isotope ratio. Geochemical data, including barium, are reported from various river samples located in the study area. Organic carbon and nitrogen data from boxcore sediment samples collected in Amundsen Gulf, Peel Sound and Viscount Melville Sound are also presented. Zooplankton taxonomy and biomass data from Amundsen Gulf and Peel Sound are reported. Sampling and analysis methods are described for all data reported. Other samples collected during the expedition, not reported here, are also listed.

RÉSUMÉ

McLaughlin, F., Carmack, E., O'Brien, M., Arfeuille, G., Barwell-Clarke, J., Sutherland, N., Tuele, D., Gatien, G., Melling, H., Zimmermann, S. and Corkum, M. 2009. Physical and Chemical Data from the Canadian Arctic Archipelago, August 23 to September 8, 1999. *Can. Data Rep. Hydrogr. Ocean Sci.* 179: vii + 140 p.

Les propriétés physiques et chimiques de l'eau dans l'archipel Arctique canadien (AAC) ont été mesurées lors d'une expédition menée à bord du NGCC *Sir Wilfrid Laurier*, du 23 août au 8 septembre 1999 (mission numéro 1999-24 de l'Institut des sciences de la mer). L'objectif de cette croisière était d'étudier le déplacement de l'eau douce ainsi que les flux de carbone et de nutriments dans Amundsen Gulf et Peel Sound, deux des trois principaux sous-bassins de l'archipel Arctique canadien. Les données océanographiques rapportées concernent la conductivité-température-profondeur (CTD), la salinité, la teneur en oxygène dissous, en orthophosphate, en silicate, en nitrate, en chlorurofluorurocarbones et en tétrachlorure de carbone, et le ratio des isotopes de l'oxygène. Des données géochimiques, y compris la teneur en baryum, sont rapportées pour divers échantillons prélevés dans des cours d'eau situés dans la zone d'étude. Sont également rapportées les données sur le carbone organique et l'azote d'échantillons prélevés au carottier à boîte dans le golfe d'Amundsen et le détroit de Peel, et dans le détroit Viscount Melville. On présente les données sur la taxinomie et la biomasse du zooplancton dans le golfe d'Amundsen et dans le détroit de Peel. Les méthodes d'échantillonnage et d'analyse sont décrites pour toutes les données rapportées ici. D'autres échantillons prélevés au cours de l'expédition, non traités dans le présent rapport, sont également mentionnés.

ACKNOWLEDGEMENTS

The success of this program was due to the co-operation, professionalism and flexibility of Captain Anderson and his chief officer, Duke Snider. With Captain Anderson's experience we were able to make good decisions regarding our sampling program in order to accomplish our goals within the time available to us. We valued the contributions of the entire ship's crew, including the officers and mates on the bridge who kept station and logs; the bosun and deck crew who operated the winches and cranes that deployed, recovered and, most importantly, safeguarded personnel and equipment; and the logistics and support crew who also assisted our work and made us feel most welcome.

This work was jointly supported by the Federal Panel on Energy Research and Development (PERD), the Ocean Climate Program (OCP) and Fisheries & Oceans Canada.

1. INTRODUCTION

This project was carried out aboard the ice breaker *CCGS Sir Wilfrid Laurier*, Institute of Ocean Sciences (IOS) Mission Number 1999-24. The field work was performed from August 23rd to September 8th, 1999, in the Canadian Arctic Archipelago, from Bellot Strait in the east to Prince of Wales Strait in the west. Giles Arfeille remained onboard after the science team disembarked and continued to collect conductivity-temperature-depth (CTD) casts.

The key scientific objectives of this mission were:

1. To study sub-basin circulation and transport of freshwater through Peel Sound, Coronation Gulf and Amundsen Gulf.
2. To investigate buoyancy boundary currents in the study area.
3. To estimate the productivity and carbon flux in Amundsen Gulf and Peel Sound.
4. To collect geochemical tracer samples from rivers flowing into the study area, time permitting.
5. To evaluate the feasibility of collecting methane samples from permafrost lakes by inflatable boat, time permitting.

Freshwater transport from the Arctic Ocean plays an important role in the global climate system and the Canadian Arctic Archipelago constitutes one of two possible routes that connect the Arctic Ocean with the North Atlantic. The objective of this cruise was to study the distribution of freshwater in Amundsen Gulf, Coronation Gulf and Peel Sound and the flux of carbon and nutrients in Amundsen Gulf and Peel Sound, two of the three main sub-basins of the Canadian Arctic Archipelago. The Canadian Arctic Archipelago is a biologically rich region and climate change will have a significant impact on productivity. For example, a reduction of seasonal ice cover may have serious consequences for seals and polar bears that use the ice to breed and raise their young. Changes in the timing of phytoplankton blooms are likely to have an impact on diversity within the food web, from zooplankton populations to beluga whales, and productivity occurring during a longer summer season may be limited by the supply of nutrients.

The scientific team was comprised of seven researchers from IOS (Appendix 4.1, Table 9). The data assembled in the present report include the standard supporting oceanographic determinations of CTD profiles and bottle measurements for salinity, nutrients, dissolved oxygen, chlorofluorocarbons (CFCs), carbon tetrachloride (CCl_4) and oxygen isotope ratio ($\delta^{18}O$). Geochemical data, including barium, are reported from various river samples located in the study area. Data from sediment core sections include moisture content, inorganic carbon, inorganic nitrogen and carbon/nitrogen ratios. The zooplankton data reported include taxa and numbers of individuals. Methane samples collected in a tundra lake and barium water column samples were not analyzed.

1.1 FIELD WORK SUMMARY

Mission #1999-24 activities and accomplishments are listed below. Data summarized in this report are outlined in **bold font**.

All scientific objectives were completed, including the occupation of 66 CTD stations, the collection of 25 geochemical water profiles, two boxcores, two zooplankton tows and the deployment of one mooring. Specifically, we:

- **Completed CTD and geochemical sections across Peel Sound, Coronation Gulf and Amundsen Gulf to study sub-basin circulation.**
- **Completed CTD and geochemical sampling along sections across channels controlling flow in and out of Coronation Gulf, i.e. across Dolphin and Union Strait.**
- **Completed a CTD and geochemical section across Prince of Wales Strait to identify the water mass characteristics of waters flowing out of the Arctic Ocean via Viscount Melville Sound.**
- **Completed a CTD section in James Ross Strait to study buoyancy boundary currents.**
- **Collected boxcore samples from Peel Sound and Amundsen Gulf to estimate sedimentation rates and carbon fluxes.**
- **Collected zooplankton tows in Peel Sound and Amundsen Gulf to identify population constituents.**
- Deployed a sediment trap and current meter mooring in Amundsen Gulf for a year-long collection of samples to estimate seasonal productivity.
- **Began a survey of CTD and geochemical stations linking Arctic Ocean waters with Baffin Bay waters to study water mass modification and Archipelago throughflow.**
- Collected dissolved methane samples from three lakes. These samples were not analyzed in a timely manner (at the University of Victoria) and were discarded. The technique for collecting lake samples using a small boat carried in the helicopter was successful.
- **Collected geochemical tracer samples from five rivers to establish source water signatures of rivers emptying into the Archipelago.**

1.2 STUDY AREA

Figure 1 through Figure 8 show the station locations in the Canadian Archipelago during the 9924 mission. The locations for CTD/Rosette and CTD casts were taken from the ship's GPS navigation system on the bridge. Table 10 in Appendix 4.2 provides a chronological list of the cast locations (at the start of the cast). If more than one cast was done at a station, coordinates are listed for each cast.

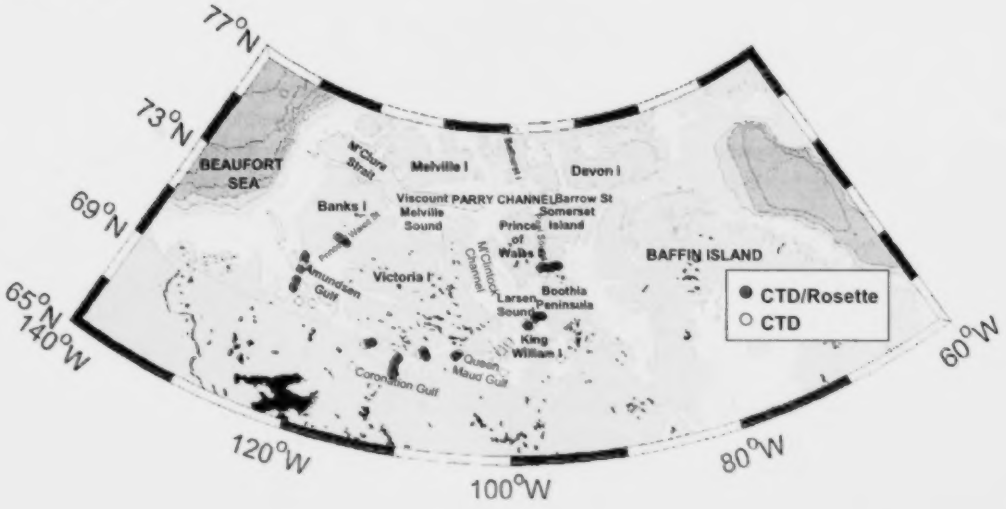


Figure 1. Mission 9924 science station sampling locations.

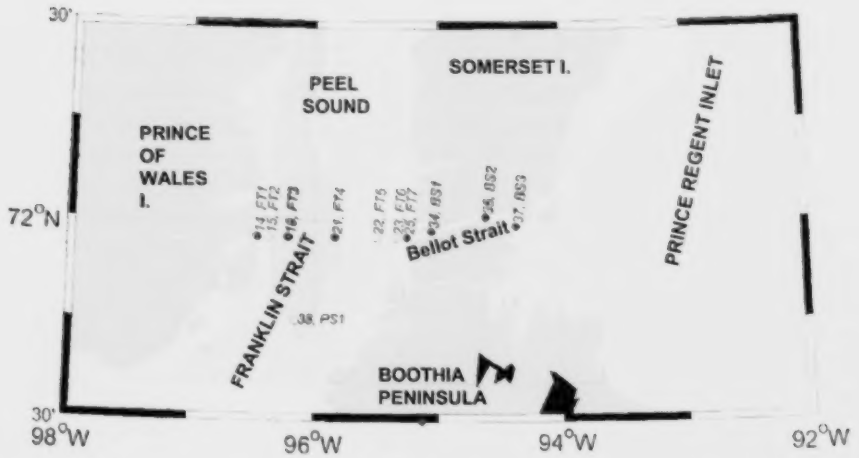


Figure 2. Location of stations in Bellot Strait and across Peel Sound.

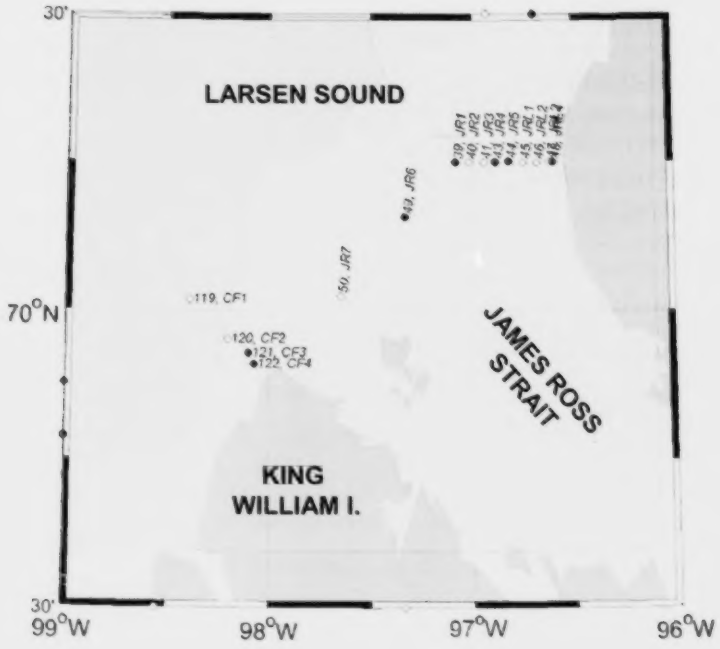


Figure 3. Location of stations in James Ross Strait.

Figure 4. Location of stations in Queen Maud Gulf, Victoria and Rae straits.

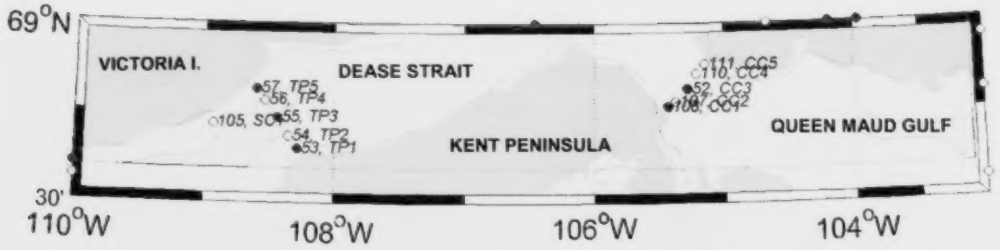


Figure 5. Location of stations in Dease Strait and Queen Maud Gulf.

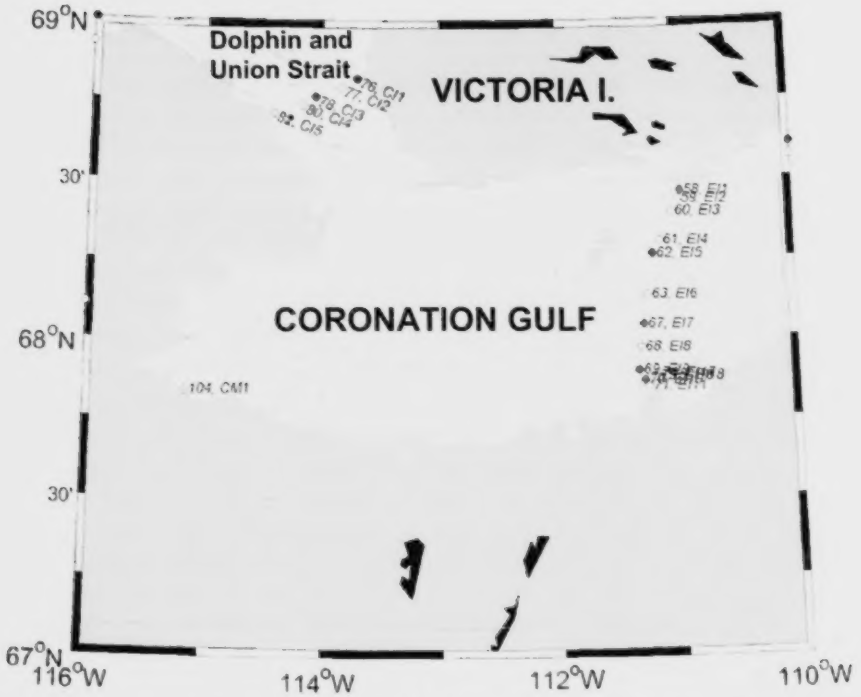


Figure 6. Location of stations in Dolphin and Union Strait and Coronation Gulf.

Figure 7. Location of stations in Amundsen Gulf and Prince of Wales Strait.

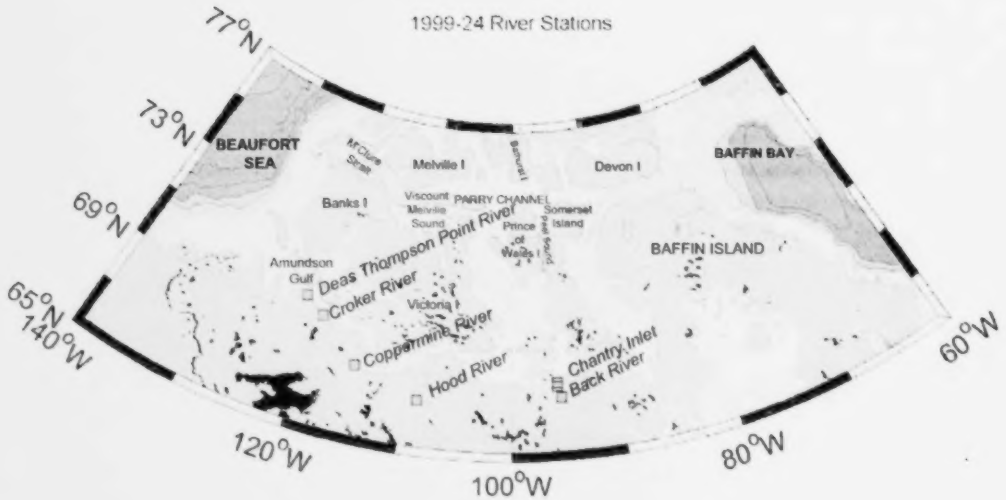


Figure 8. River sample locations.

2. METHODS AND ANALYSIS

For the 1999 field season, the ship was newly equipped with deck gear and work spaces to make her capable as a science platform: winches and an A-frame were installed on the well-deck for deployment and recovery of science moorings; a removable container was adapted as lab/workspace for science activities; a CTD winch and a smaller A-frame were installed on the boat deck. The former radio room had been upgraded with expanded counter tops, improved lighting and an isolation transformer and UPS for conditioning the ship's power for science electronics and served as a data processing and chemistry laboratory. A Simrad EK-500 deep sounder provided bottom depths for CTD profiling and in the deployment and recovery of oceanographic moorings.

CTD and CTD/rosette casts were deployed from the boat deck using an A-frame and winch mounted on the port side. The bosun or mate operated the CTD winch throughout the cruise. Operation of the winch by ship's crew was invaluable because it allowed direct communication to occur between the boat deck and the bridge. Such communication is mandatory because bridge personnel cannot see equipment over the side or the wire angle directly. For example, in one instance when the wire was snagged a large piece of ice, direct, rapid communication was critical to the safety of personnel and equipment.

The recent conversion of the radio room into a fully operational oceanographic laboratory was a success. The conversion permitted oxygen, nutrients and CFCs to be analyzed immediately onboard which provided the program with timely field data. This allowed the sampling program to be modified according to our findings. In addition, the close proximity of the lab and the rosette meant that station sampling could be performed quickly and efficiently.

Boxcores, zooplankton net tows and the mooring were also collected or deployed from the foredeck using the ship's crane, IOS A-frame and winch. The foredeck container provided a warm, dry workspace for assembling, cleaning, and testing instruments and for subsampling. All deployments of the boxcore, nets and mooring were directed by the bosun.

2.1 FIELD SAMPLING – CTD/ROSETTE CASTS

Profile data were taken with a Guildline 8707 CTD (S/N 43825), installed for use with a conducting sea cable for real-time data acquisition. This CTD was mounted on a Seabird SBE-32 Carousel sampling rosette which contained 12, 8 L Niskin bottles and with an internally recording Seabird SBE-19 CTD (S/N 2688) and a Seabird Auto Firing Module (Figure 9). The SBE-19 CTD was primarily used to close the Niskin bottles by providing the pressure data to the Auto Firing module on the Carousel sampling rosette, which triggered Niskins at pre-selected depths.

Prior to each rosette cast, the auto-fire module was programmed with the bottle depths using Seabird software SeatermAF. The battery powered SBE-19

CTD was turned on prior to the cast deployment. The frame was lowered into the water and the Guildline CTD data acquisition was started with data recording to a PC in real time through the conducting cable. The frame was lowered and raised at slightly less than 1 m/s. All casts were lowered to within 20 m of the ocean floor. The Niskin bottles were closed on the upcast without slowing the frame's ascent rate.

A science logbook was kept in the lab near the data acquisition computer to log the particulars at each station. The position coordinates for the station and the date and time (UTC) at the start of each cast were noted. Following each cast: the raw Guildline CTD temperature and salinity were plotted to ensure that the sensors were functioning properly; data from the SBE-19 CTD and the auto-fire module were downloaded to a PC computer; and a spreadsheet file was updated with cast information from the logbook.

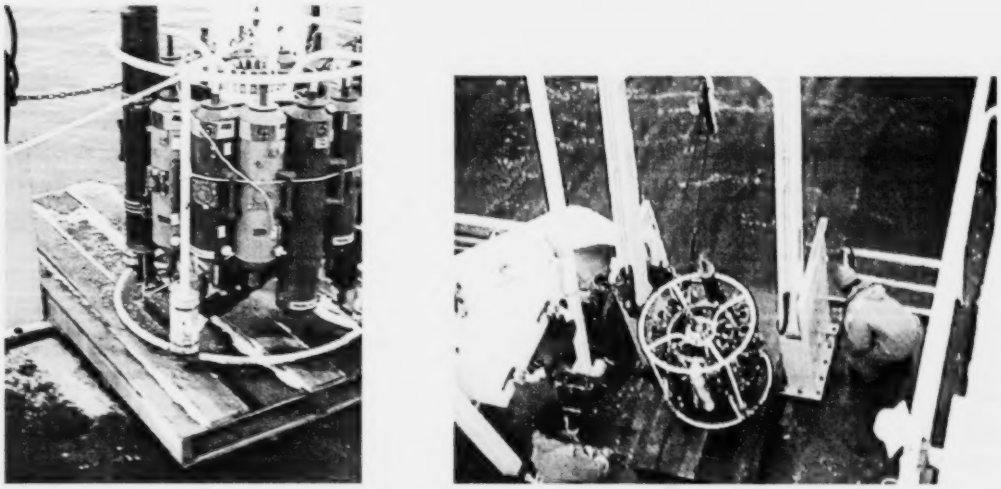


Figure 9. CTD/Rosette set up.

2.2 PROCESSING AND VALIDATION OF CTD DATA

Two CTD instruments were used: the primary, due to better data quality and sensor stability, was a Guildline 8707 CTD attached to the conducting wire and real time data was recorded on the acquisition PC. The secondary CTD, the internally recording SBE-19, was required to close the Niskin bottles. The SBE-32 water sampler responded via the auto-fire module to the SBE-19 pressure reading, closing bottles at pre-set depth criteria. The SBE-19 CTD had a Sea-Tech Transmissometer (S/N 139, 25 cm path) attached. The SBE-19 CTD data were of varying quality with occasional bad profiles and common hysteresis. The data from this CTD are not reported. Transmissometer data are not reported here but are available.

The main issues requiring attention in the data processing:

- Problems in the temperature data appeared as shifted values, either single or in groups, and were probably associated with a malfunction of the Range/Suppression encoding of temperature by the A/D converter in the CTD. Each cast needed editing to remove bad points.
- Finding the correct CTD data associated with each Niskin bottle closure.
- Upcast data are reported instead of the downcast data on 5 of the casts (Casts #25,74,103,107,110) due to corrupt temperature data.

Table 1 lists the accuracy of the CTD sensors.

Table 1. CTD accuracy.

Sensor	Accuracy	Applied Lab Calibration	Correction after Lab Calibration	Comment
Pressure	0.5 db	Post cruise	+0.5 db	
Temperature	0.01 °C	Pre cruise	None	Pre to Post cruise Lab cal difference
Salinity	0.01 PSU	Pre cruise	-0.014 PSU	Deep CTD – salt difference

See Appendix 4.3.1 (Table 11 and Table 12) for CTD sensor calibration information.

2.2.1 Processing Steps

The steps outlined below were performed as required in processing data from each CTD cast. The protocols for processing the CTD data are documented in detail in an IOS internal document by Pearson (1995). Derived oceanographic quantities were calculated from the pressure, temperature and salinity data using the algorithms given by Fofonoff and Mallard (1983). See Appendix 4.3.2, Table 13, for Mission 1999-24 rosette stations, cast numbers and corresponding data files. Refer to Appendix 0 for plots of CTD data and Appendix 4.5 for maps of dynamic height and temperature and salinity sections.

Processing of the CTD data involved the following general steps:

- verification of calibration coefficients for all sensors
- verification against log sheets of data files produced by the acquisition programs
- checking and editing the header information
- conversion of the CTD data files from their acquired format into IOS HEADER format
- application of sensor calibrations to the "raw" data
- creation of profile plots throughout the processing
- removal of data spikes and corrupted data
- correction for differences in temperature and conductivity time responses (method used is dependent on CTD type)
- deletion of swells, upcast and unwanted surface records

- removal of salinity spikes
- manual editing of other data problems where required;
- reduction of the data to one meter averaged values
- production of final test plots
- creation of overlay plots and comparison of CTD data with bottle data, other reference data and historical data
- adjustment of the processed CTD data to agree with reference data

2.2.2 Data Spikes in Temperature and Conductivity

Auto-despiking removed some of the bad data including most problems in conductivity. However, the temperature record was corrupted by bad data that tended to come in small groups where the sensor seemed to get stuck for a few records (typically 5 to 10 points); these had to be interpolated individually.

Of the 86 CTD casts performed, records were removed or salinity edited in 40 of the casts in the upper 20 m and in 22 of the casts below 20 m.

2.2.3 Pressure

Although surface pressure offsets are usually examined to determine if offsets should be applied, the Guildline CTD acquisition commenced and ended while the CTD was in the water and thus surface pressure information was not regularly available. It was determined an offset of +0.5 db should be applied to pressure based on data from IOS Mission #9925, conducted aboard the *Sir Wilfrid Laurier* with the same equipment.

2.2.4 Temperature

The pre- and post-cruise laboratory calibration of the temperature sensor shows a shift occurred between calibrations (June, 1999 and February, 2000). The change ranges from +0.007 °C at -2 °C, +0.005 °C at +2 °C, to +0.002 °C at 9 °C. The SBE-19 CTD data were examined for comparison but the errors in the SBE-19 data were too large to determine when the shift occurred. In addition, the pre- to post-cruise calibration shift in the SBE-19 was of the same magnitude, but in the opposite sense, which further confounded the investigation. Data were processed using the pre-cruise calibration coefficients and the precision of the data reduced because of the calibration shift.

There were also problems with the temperature data in the form of shifted values, either single points or groups of points. Every cast needed editing to remove the shifts. It is thought the shifting was due to a problem with the Range/Suppression encoding of temperature by the A/D converter in the CTD.

2.2.5 Salinity Calibration

Averaging the 11 bottles collected from 200 m to 550 m, the Guildline CTD was found to give salinities high by 0.014 PSU. The CTD salinity was corrected

by applying a -0.014 PSU offset. After correcting for this offset, an examination of just the deep bottles (300 to 600 m) from station AG5 shows the CTD salinity is higher than the bottles by 0.007 PSU. Possible causes for this discrepancy were examined: shifting calibration from the CTD hitting the bottom; problems with specific salinity samples; problems identifying the correct AFM bottles; or pre- to post-cruise shifts in temperature or conductivity. Historical data were also examined but these investigations did not reveal a clear explanation. The CTD data were left with an offset of 0.007 below 300 m relevant to station AG5 only.

2.2.6 CTD Data at Bottle Depths for Water Chemistry File

The CTD pressure, temperature and salinity data associated with the water samples were obtained from the Guildline CTD's downcast. These data were found by matching the SBE-19 CTD upcast bottle trip pressure to the Guildline CTD pressure after correcting for the SBE-19 surface offset (1 to 2 db, depending on the station), sensor to bottle center offset (-0.6 db), and an additional offset of +0.2 db. By comparing CTD and bottle salinities it was determined that no further offset was required to correct for bottle flushing and fluid dynamic effects caused by the rosette package. This decision was based on histograms of CTD and salinity sample differences for casts that had bottle pressure records (the exceptions are discussed in the following paragraph). Offsets of 1 db increment between +2 and -2 db were tested. Both 0 and 1 db (CTD data from 1 db deeper) results were very similar with low skew and low standard deviations. The 0 db offset was chosen; refer to Figure 10 through Figure 13.

Some stations were missing SBE-19 bottle trip pressures. For these stations, the Guildline CTD data were found by taking the records where bottle salinities matched the CTD salinities (Table 2). The nature of this method already accounts for the pressure offsets, thus no further corrections were applied. This method assumes no leaks and that the CTD salinity is perfectly calibrated. The accuracy of picking out the right depth with this method is highest in the upper water column where the vertical salinity gradient is highest. The pressure and the nominal pressure were compared to verify there were no large differences. At Station JRL4 CTD data (cast 48) was obtained by estimating pressure for a sample collected by bucket. Refer to Appendix 4.3.2 for Germaine Gatien's detailed Guildline CTD processing summary.

Table 2. List of casts where CTD data was selected by matching salinities.

Station	Guildline CTD Cast
FT2	14
FT3	18
BS2	35
JR1	39
JR4	43
EI9	69
CI1	76

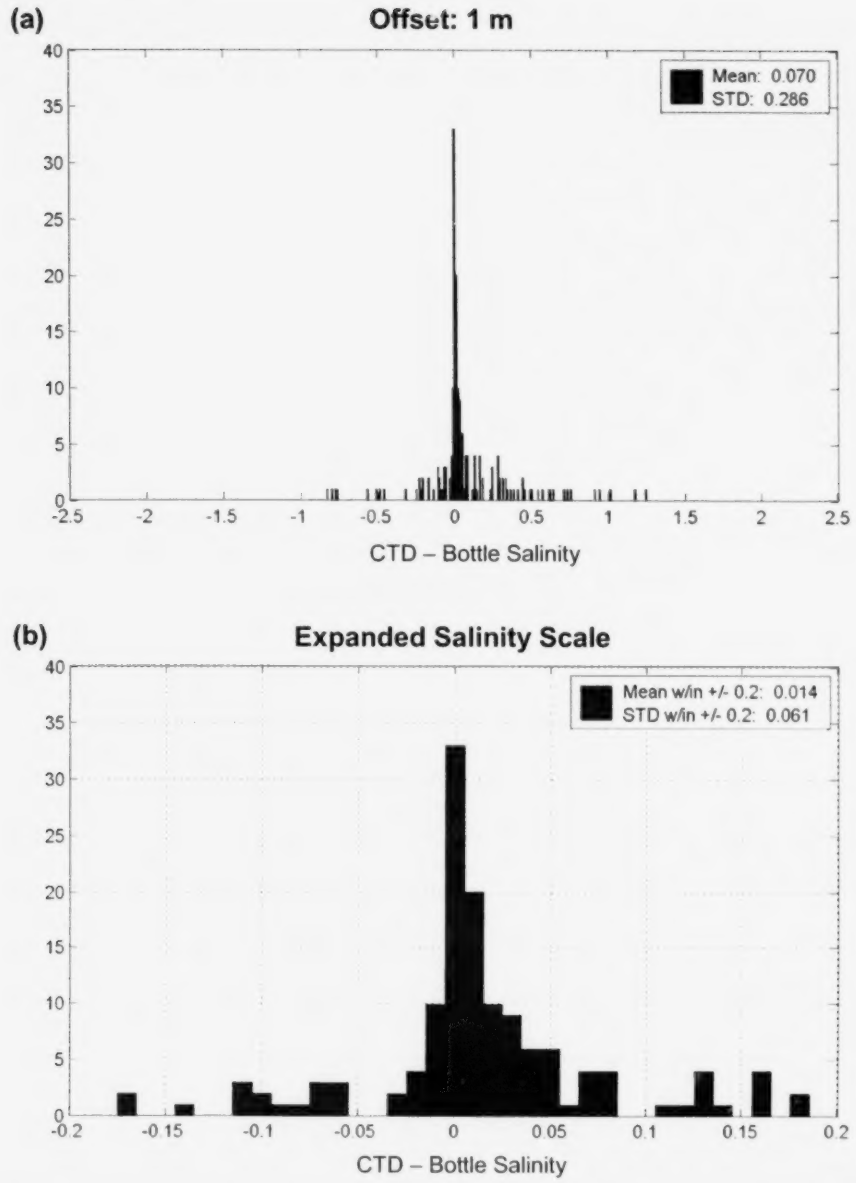


Figure 10. Histograms showing CTD-Bottle salinity differences with a +1 m offset applied in (a) full scale and (b) expanded salinity scale.

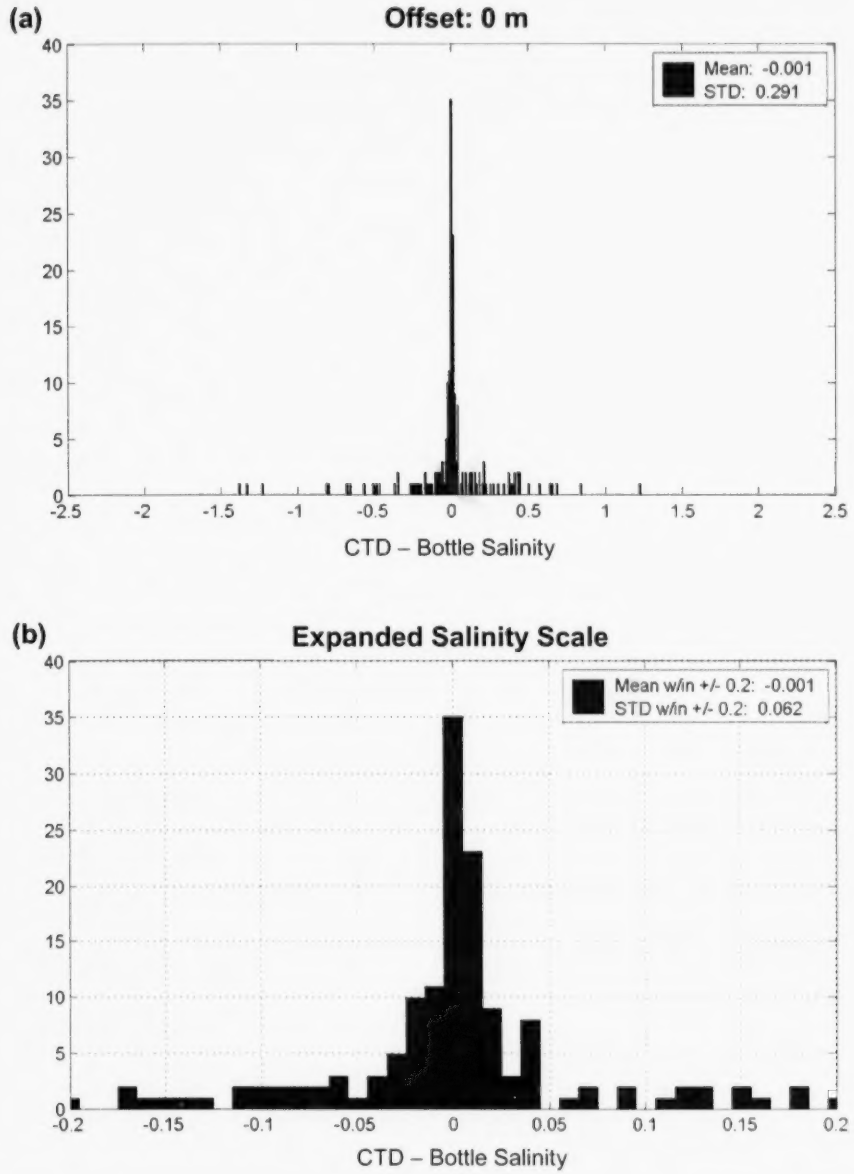


Figure 11. Histograms showing CTD-Bottle salinity differences with a 0 m offset applied in (a) full scale and (b) expanded salinity scale.

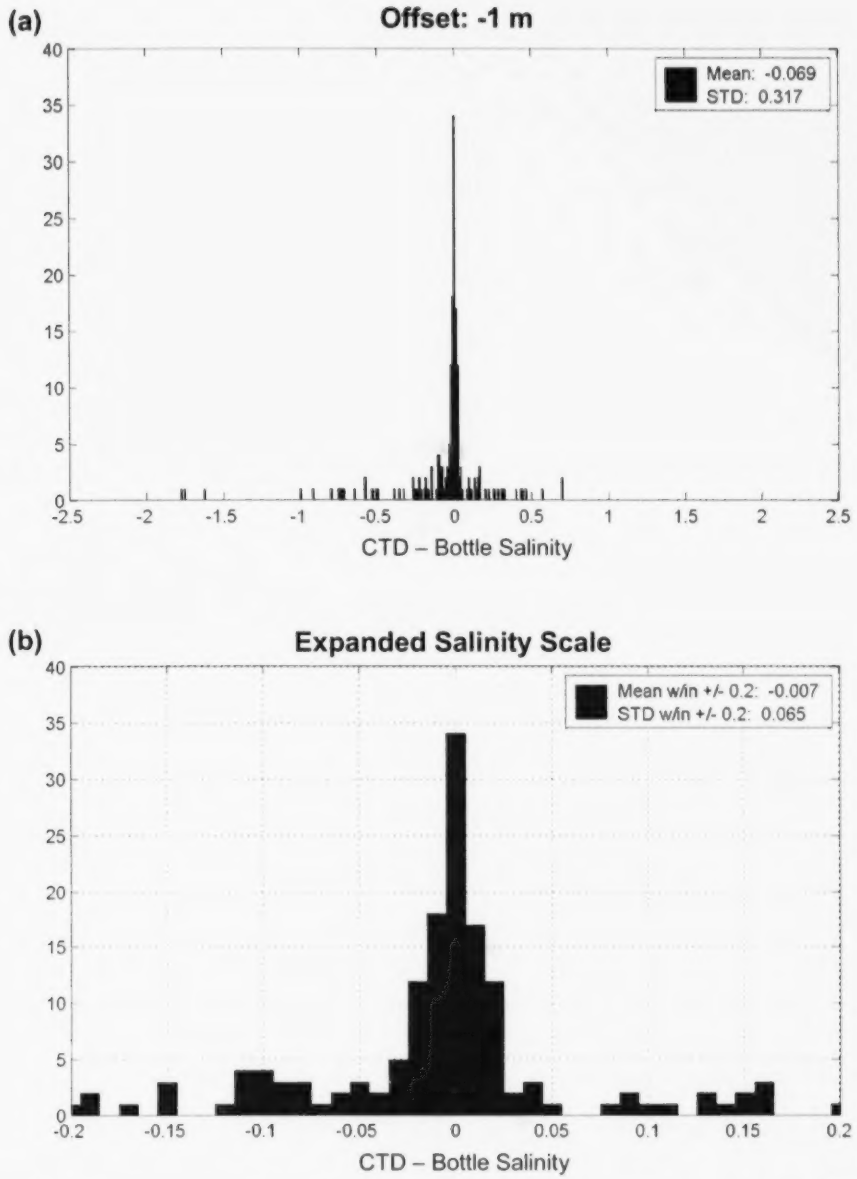


Figure 12. Histograms showing CTD-Bottle salinity differences with a -1 m offset applied in (a) full scale and (b) expanded salinity scale.

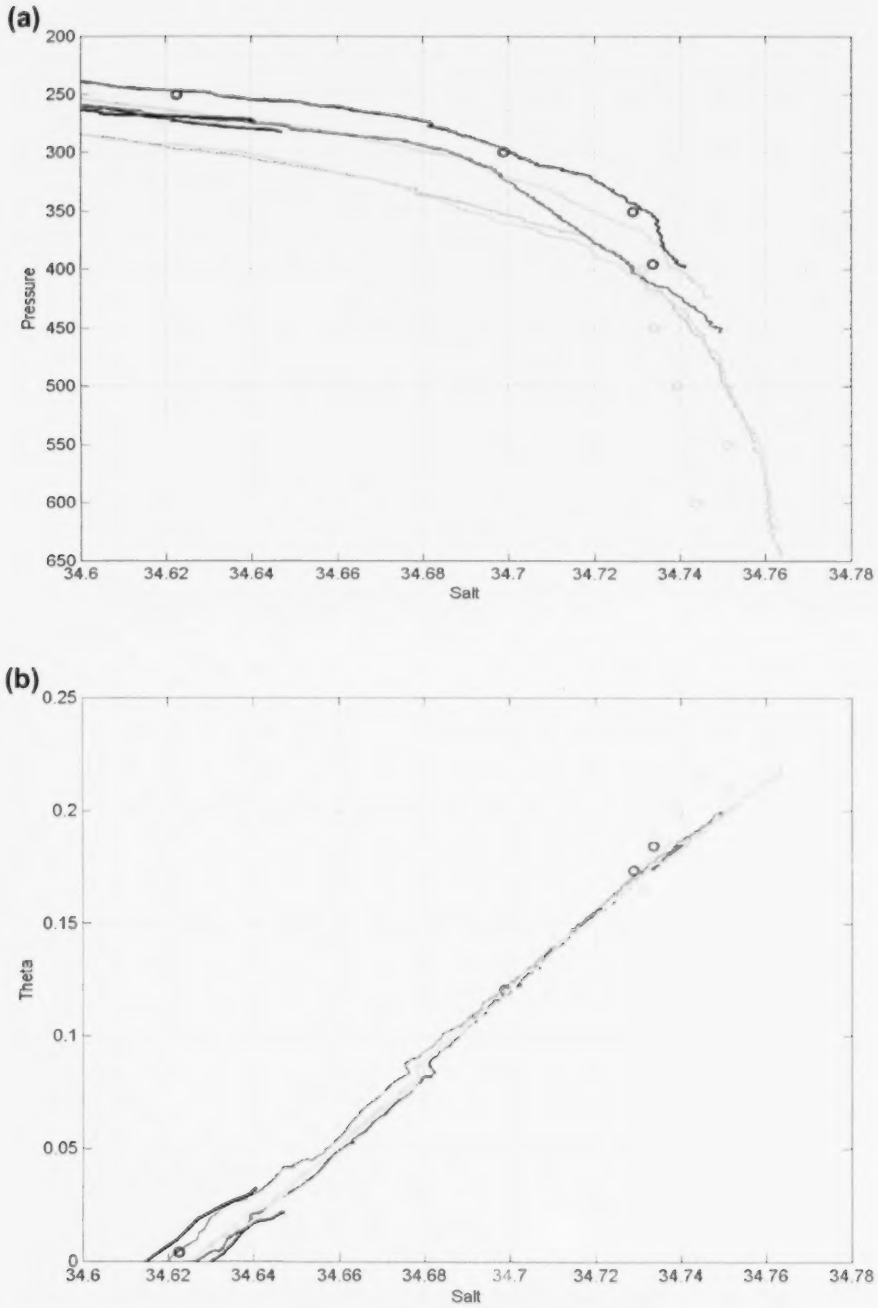


Figure 13. (a) Salinity profile and (b) Theta - Salinity plot. These figures show larger CTD v. Bottle differences in the deep waters of Amundsen Gulf.

2.3 WATER CHEMISTRY SAMPLE COLLECTION AND ANALYSIS

Samples were drawn from 8 L BOT bottles on the 12 bottle GO rosette, outside on the deck with a tarpaulin rigged over the sampling area. The order of sampling was: CFC; dissolved oxygen; nutrients; oxygen isotopes; barium; and salinity. CTD casts and water sampling were coordinated and the data at bottle trip depths are illustrated in Appendix 0 together with water chemistry data; see Appendix 4.5 for oxygen and nitrate sections.

2.3.1 Laboratory Methods

The precision of the methods was estimated by analyzing replicates and expressed as the pooled standard deviation (s_p) using the equation:

$$s_p = \sqrt{\frac{\Sigma\ (c(1)-c(2))^2}{2n}}$$

where $c(1)$ and $c(2)$ are the concentrations of duplicate samples and n refers to the number of pairs (Table 3).

Table 3. Water Sample Precision

Chemistry Sample	Precision (s_p)	Number of Duplicate Pairs	Minimum Concentration	Maximum Concentration
Salinity	NA	NA	23.668 PSU	34.751 PSU
Dissolved Oxygen	0.02 mL/L	24	5.2 mL/L	10.4 mL/L
Nitrate+Nitrite	0.05 mmol/m^3	67	0.0 mmol/m^3	17.0 mmol/m^3
Silicate	0.20 mmol/m^3	69	2.1 mmol/m^3	39.7 mmol/m^3
Ortho-phosphate	0.03 mmol/m^3	35	0.40 mmol/m^3	1.88 mmol/m^3
Barium	0.99 nmol/m^3	3	30.5 nmol/m^3	224.3 nmol/m^3

2.3.2 *Salinity*

Salinity samples were drawn into 200 mL glass salinity bottles after being rinsed 3 times. The samples were then tightly capped and transported back to IOS for analysis. Samples were analyzed from November 22nd to the 25th, 1999, on a Guildline Portasal (Model 8410; Serial number 59724) by Doug Sieberg at IOS. Data are reported in practical salinity units (PSU; Lewis and Perkin 1978). The salinometer was standardized against Standard Sea Water of salinity IAPSO standard seawater (batch P134). No duplicate samples were taken.

2.3.3 *Dissolved Oxygen*

Samples for dissolved oxygen were drawn after the CFCs samples. Water was drawn through rubber tubing into a calibrated volume glass flask with attached stopper. The sample was immediately pickled with 1.0 mL of manganous chloride and 1.0 mL alkaline iodide, the stopper was inserted and the flask was shaken to mix the contents. Dissolved oxygen samples were analyzed on board by Mary O'Brien within 24 hrs of collection using an automated version of the Micro-Winkler Technique as described in Carpenter (1965). The titration was performed using a Metrohn Dosimat 665 and the end point was detected using a Brinkmann probe colorimeter PC900. The methodology is described in an internal IOS document (Minkley and Chase 1997). Standard pooled deviation for 24 duplicates for the oxygen analysis was 0.02 mL/L. Note: only the first replicate of a duplicate pair is reported in the IOS data archive.

2.3.4 *Nutrients*

Nutrient (silicate, nitrate + nitrite and orthophosphate) samples were analyzed onboard by Janet Barwell-Clarke. Water samples for nutrient determination were collected into glass and polystyrene test tubes (two glass and two polystyrene tubes per sample) after three rinses. Nutrients were analyzed using a Technicon Autoanalyzer II using colorimetric methods reported in Barwell-Clarke and Whitney (1996). A subset of the duplicates were analyzed and used to calculate the pooled standard deviation (s_p): nitrate + nitrite is s_p = 0.05 mmol/m^3, where n = 67; silicate s_p = 0.20 mmol/m^3, where n = 69; and orthophosphate s_p = 0.03 mmol/m^3, where n = 35.

Standards and blanks:

Nanopure water was analyzed at the beginning and end of each analysis day to verify the chemical blank. Standards (low, medium and high) were made using a freshly prepared 3.2% sodium chloride solution and analyzed at the beginning and end of each day and every ~60 samples. Concentrations of the standards bracket the expected nutrient levels in the samples.

When the nitrate level in surface samples was the same or slightly lower than the 3.2% sodium chloride solution it was reported as zero.

2.3.5 *CFCs*

After the Niskin bottle integrity was checked the first sample to be drawn was the CFC sample. The sample was collected into a 250 mL glass syringe that had been rinsed three times, without the intake of any bubbles. Nes Sutherland analyzed CFC-12, CFC-11, CFC-113 and CCl4 samples using the IOS automated purge and trap system. Separation and detection of the components was achieved using a 60 m, 0.32 mm GasPro Gas fused silica column installed in a Hewlett Packard gas chromatograph and electron capture detector. Standardization was done using a gas standard (S14) made at Brookhaven National Laboratories and standardized at Scripps Institute of Oceanography and reported with respect to the SIO1993 scale. Air samples were collected as a secondary check on the operation of the system. Samples were not collected in duplicate.

2.3.6 *Oxygen Isotope Ratio* ($\delta^{18}O$)

Samples were drawn into ~30 mL glass vials following three rinses of the vials. Once at room temperature, the caps were retightened and wrapped with electrical tape for storage. Samples were not collected in duplicate. Oxygen isotopes were analyzed in 2000 at the Stable Isotope Laboratory at the University of Calgary (UC).

Overview

The $^{18}O/^{16}O$ ratio of natural waters was determined using the common CO_2-H_2O equilibration technique (Epstein 1953; O'Neil et al. 1975) where millimole quantities of CO_2 were equilibrated with water samples under constant temperatures. Subsequently, the CO_2 was cryogenically purified and $^{18}O/^{16}O$ ratio was determined by mass spectrometer. Note that this technique measures the isotopic activity of ^{18}O and not the actual ^{18}O concentration. For dilute waters, differences between isotopic activity and concentration are negligible. For saline waters and brines, however, supplemental water chemistry data and longer equilibration times are needed to obtain true isotopic compositions (Horita 1993; Sofer 1972).

Details of $\delta^{18}O$ analysis

1. Aliquots of water samples were equilibrated with CO_2 typically for 18 hours. During the equilibration period, samples were kept at a constant temperature and are shaken gently.
2. Between 0.5 and 5.0 mL water was typically used for analysis.
3. Internal lab standards were analyzed repeatedly within each sample set (one standard per five samples) to guarantee quality control.
4. The pH value of the water samples must be in a range such that H_2CO_3 and HCO_3^- are abundant (pH = 6 to 7).

5. After 18 hrs of equilibration, the CO_2 gas was cryogenically purified. Subsequently, the $^{18}O/^{16}O$ ratio was analyzed either by dual inlet isotope ratio mass spectrometry (Micomass 903), or by continuous flow isotope ratio mass spectrometer (Gilson sampler + VG Sira 10).

Mass spectrometric measurements

1. The obtained "raw" $\delta^{18}O_{H2O}$ values were drift corrected and normalized using internal laboratory standards.
2. Internal laboratory standards (CW: Calgary water, SW: seawater) were calibrated periodically using international standards [V-SMOW (Vienna-Standard Mean Ocean Water), V-SLAP, V-GISP].
3. Isotopically enriched water samples were calibrated using additional standards with positive $\delta^{18}O$ values provided by the IAEA (e.g. IAEA 302 and 304).
4. Corrected $\delta^{18}O_{H2O}$ values were reported in the per mil (‰) notation relative to V-SMOW.

The oxygen isotope ratio is referenced to Vienna-Standard Mean Ocean Water (V-SMOW) and reported as follows:

$$\text{(V-SMOW):}\ \delta^{18}O = ((H_2{}^{18}O/H_2{}^{16}O)_{sample} / (H_2{}^{18}O/H_2{}^{16}O)_{VSMOW} - 1) \times 10^3\ [‰].$$

Accuracy and precision for $\delta^{18}O$ values of natural waters was generally better than ±0.2‰ (one standard deviation based on n = 50 lab standards). However, there was drift in the UC instrument and there is no means of quantifying this drift because gas pressure operation and other data were not recorded. Reruns relied on the operator identifying a problem. There were also problems due to power fluctuations.

2.3.7 Barium

Barium samples were drawn from the Niskin or collected by hand from the various rivers into small plastic vials following three rinses of the vials. Once at room temperature, the caps were retightened and wrapped with Parafilm for storage. Only the river samples were analyzed under the direction of Kelly Falkner at Oregon State University using isotope-dilution and a VG Thermo Excel Inductively coupled quadrupole mass spectrometer. The method was reported by Falkner et al. (1994) with minor modifications. The pooled standard deviation, based on 3 duplicate pairs, is 0.99 nmol/m^3. These samples were analysed as part of a larger analysis in 2000 (with samples from Mission 2000-22) where a seawater "consistency" standard was analyzed 54 times, yielding a standard deviation of 2.57 nM (Table 4). See Appendix 4.6, Table 14 for river barium data.

Table 4. Barium standard calibration for river samples.

Sample	Ba (µmol/m^3)		
Seawater consistency standard	107.51	Average of 54 runs	
	2.57	StDev	
	2.39	CV	
GEOSECS Samples	**Measured Ba (nmol/Kg)**	**Expected value L.Chan (nmol/kg)**	**Percent Difference**
1C	110	112.9	-2.58
3C	41.6	42.4	-1.92
4C	61.7	63	-2.07
5C	92.8	93.6	-0.88

2.3.8 Methane

Methane samples were collected at three tundra lakes. The samples were sent to the University of Victoria but were not analysed or kept.

2.4 OTHER FIELD SAMPLING

2.4.1 Vertical Net Tows

Zooplankton sampling was conducted on board using a paired Bongo net assembly. Two large bongo frames held nets with mesh size 235 µm and the sampling area for each net was 0.2427 m^2. The two nets contained uni-directional flowmeters to measure the amount of water flowing through the nets (TSK flow meter Model 1201, S/N 5255, constant = 0.15072). The volume sampled per tow is determined by multiplying the net area (0.2427 m^2) by the constant (0.15072) and the volume recorded by the flowmeter. For Station FT3 the volume is 23.23 m^3 and for Station AG5 the volume is 19.94 m^3.

Samples from one cod end were preserved in 10% buffered formalin and used for taxonomy. Samples from the other net end were put into whirl-pak bags, double-bagged and stored immediately in the -80 °C freezer for determination of biomass (not done). Biomass was calculated by multiplying the abundance (number per m^3) by the average weight of the organism. The average was weight was either determined at IOS or a value taken from the literature. Appendix 4.7, Table 15 reports zooplankton taxonomy data as abundance and biomass; Table 16 provides a summary of zooplankton taxonomy reported as biomass only.

Zooplankton Taxonomic Analysis

Formalin preserved samples were poured over a 4 mm sieve stacked on a 0.2 mm sieve (bottom sieve was equal to or slightly finer than the mesh size from the net used) to remove the preservative and separate the ≥5 mm size fraction from the rest of the sample. Separation was never complete but it was a good

start. Both fractions were examined to ensure that the separation was complete (Chaetognath often passed through the 4 mm headfirst) using a Wild M420 dissecting scope and Leitz Dialux 22 compound scope. Both microscopes had viewing tubes and adapters for camera or video hook up. When separation was verified, the sample was also examined for exotic or rare taxa which were removed and retained for external verification. The formalin/seawater mixture was captured for use when the sample was reconstituted after analysis. Filtered seawater was used for rinsing and sorting.

The ≥5 mm fraction was sorted into two categories as identification to species, stage, development and enumeration proceeds: ≥5 mm, <10 mm and ≥10 mm. In the database these were referred to as s1 <5 mm, s2 ≥ 5 mm <10 mm, s3 ≥10 mm. In the event of large numbers in these size classes, the ≥5 mm portion was subsampled to approximately 100 individuals. A calibrated Folsom splitter was used for all sub-sampling. It was sometimes necessary to split the Chaetognaths to a manageable subsample while the rest of the fraction could be enumerated and identified without subsampling. As each animal was identified it was removed from the sample and placed back into the original sample jar. The ≥5 mm were sorted in a Petri dish with a 1 cm grid on the bottom whose smallest demarcation was 1 mm. Rare animals of any size were identified, removed and counted on a 1 to 1 split.

The remaining size fraction, <5 mm, was split to produce a subsample of approximately 400 individuals, which were then enumerated to genus, species, sex, and developmental stage. The <5 mm animals were sorted in a 1 mm gridded Borgorov tray. Any animals that were not readily identifiable were put off to the side to be examined at the end of the sample sorting. This method was adopted to ensure that the greater ≥5 mm animals were represented. Usually the <5 mm portion overwhelmed the larger size categories in numbers, and subsampling reduced the chance of identifying the rarer species. Any animals that were unknowns (to the analyst) were set aside for outside verification of identification.

The portion of the sample that was not enumerated (the other half of the splitter) was then scanned for any rare species that would be underrepresented by the splitting and a general check on relative proportions of the counted side was performed. All subsampling was completed using a Folsom splitter, which was regularly calibrated by splitting a known sample.

In the database, s1, s2, s3, f and m (female and male) were used for almost all taxa except for copepods which were split into life stages i, ii, iii, iv, v, f, m where f and m represent the adult stage vi female or male. Data was usually presented as number of individuals of that species per cubic metre. All splits were kept to fractions, i.e. ½, ¼ ⅛, etc. When splitting with a Folsom splitter, sides were alternated; first side A then side B etc. to eliminate any prejudice.

2.4.2 *Sediment Sample Collection*

A boxcore with a stainless steel liner (0.6 m^2, 50 to 55 cm deep) was used to collect sediment samples in Amundsen Gulf and Peel Sound on the *CCGS Sir Wilfrid Laurier* and a similar boxcore with a liner about 1 x 1 x 1 m in dimension was used to collect cores in Viscount Melville Sound on the *CCGS Louis S. St-Laurent* as part of the Swedish TUNDRA Northwest 99 program (see Figure 14 for station map and Table 5 for station and sampling information).

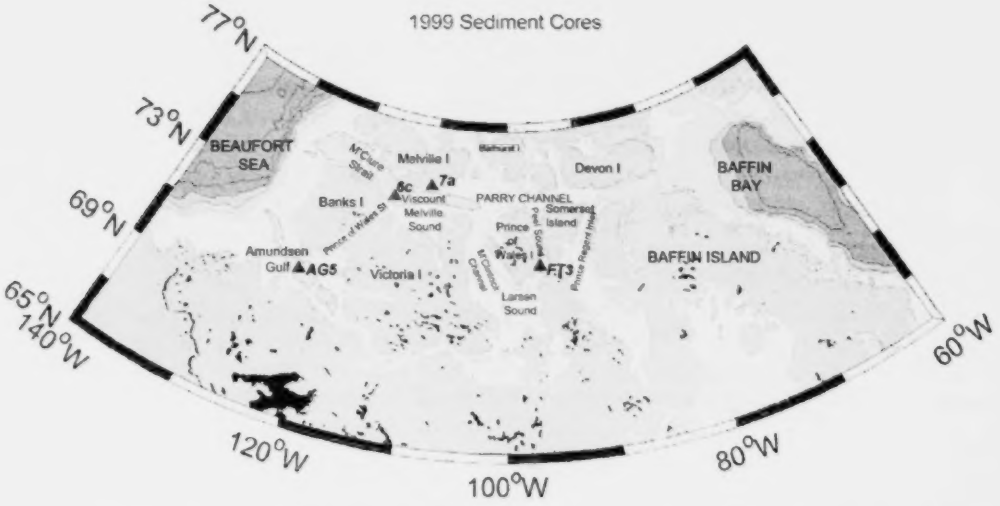


Figure 14. Location of 1999 sediment core sampling stations.

Table 5. Sediment core station information and sample core length.

Station	Latitude (°N)	Longitude (°W)	Date	Vessel	Water Depth (m)	Core Length (cm)
6c	74.02	114.43	9/12/99	*Louis S. St-Laurent*	511	*32
7a	74.62	109.97	9/13/99	*Louis S. St-Laurent*	181	**21
FT3	71.959	96.215	8/26/99	*Laurier*	460	1) 49 frozen 2) 47 frozen
AG5	70.563	122.937	9/4/99	*Laurier*	643	1) 46.8 frozen 2) 35.8 frozen 3) 43.6 cooler

* Core is marked as "39 cm" but is only 32 cm long at sectioning.
** Core is marked as "21 cm"; core tube is 21.5 cm from top to bottom.

Upon recovery the sediment cores were subsampled with 2-5 push cores (10 cm acrylic tubes; Corer Type: 4.5" KB). The cores were labeled and sealed

and placed upright in the ship's freezer. The four push cores were subsampled by Dave Paton at IOS in 2000. The cores were thawed, described and sliced into sections: the top 10 cm was sampled in 1 cm intervals, the next 10 cm was sampled in 2 cm intervals and the remaining section was sampled in 5 cm intervals (Table 6).

Table 6. Sediment core sectioning description.

0 cm	6c	7a	FT-3	AG-5
1	Brown, smooth sediment; some sand; 3 small stones	Shells; stones; coarse sand	Dark brown	Brown pellets; conifer needles
2	Brown, smooth sediment	Shells; stones; coarse sand	Dark brown	Dark brown
3		Shells; stones; coarse sand	Brown	Dark brown
4		Small stones	Brown	Dark brown
5		Clay/rock flour; some sand	Brown	Dark brown
6		Clay/rock flour; some sand	Brown	Dark brown
7		Clay/rock flour; some sand	Brown; grey band	Dark brown
8		Clay/rock flour; some sand	Brown/beige	Dark brown
9		Clay/rock flour; some sand	Brown/beige	Dark brown
10		Clay/rock flour; some sand Small black flakes (charcoal)	Brown/beige	Dark brown
11		Clay/rock flour; some sand	Brown/beige	Red-brown mottle
12		Stones; 2 cm hole with dry dirt (not sampled)		
13			Brown/beige	
14				
15	Small rocks, stones; tan sediment; some sand		Brown/beige	Grey-brown (rock flour)
16			Grey/brown	
17			Grey/brown	Grey-brown (rock flour)
18				Small rock
19	Small/med brown flecks; small stones;		Grey/brown	Grey-brown (rock flour)
20	Brown with flecks			
21			Grey/brown	
22				
23				
24				
25				
26			Grey/brown	Stone
27				Reddish band
28				Green
29				
30				Stone; rock (11/2" diameter)
31	Discarded			
32				
33				Stones
34				Stones
35				Stones
36			Compacted during sectioning	More gritty; some sand
37				
38				
39				

Each section was subsampled for radioisotope analysis (J.Smith, BIO), trace metals (C. Gobeil, IML) and carbon/nitrogen analyses (IOS). All subsamples were frozen for subsequent analysis. Only the carbon and nitrogen data (Appendix 4.8, Table 17; Figure 16 through Figure 19) and the moisture content (Table 18; Figure 20 through Figure 23) are reported here. A subset of duplicates were analyzed and used to calculate the pooled standard deviation: % Organic Carbon is $s_p = 0.012$, where $n = 4$; % Organic Nitrogen is $s_p = 0.011$, where $n = 4$; and % Moisture Content is $s_p = 0.047$, where $n = 6$. Refer to Table 7 for sediment analysis and quality checks.

Methodology: POC/PON Analysis of Marine Sediments

Marine sediment samples were oven dried at 50 °C overnight to stable weight in order to determine moisture content. The samples were homogenized with a clean mortar and pestle to a fine textured mixture. Replicate samples and a reference material (BCSS 1 Marine sediment) were analyzed during each analytical run.

Approximately 500 mg of sample (bulk sample) were weighed into a clean, pre-weighed crucible to determine the initial sample weight (W_i). Carbonates were removed by the addition of 10 mL of 1 N HCl, stirring gently until effervescence has stopped.

The samples were dried on a hot plate overnight at 70 °C to evaporate water and excess HCl, and then oven dried another 2 hours at 105 °C prior to analysis. The samples were left open to room temperature and humidity for two hours then re-weighed to determine the final weight (W_f) before sub sampling and analysis in the Elemental Analyser.

The decalcified samples were homogenized again using a clean glass rod and 8 to 12 mg sub samples were weighed into clean tin cups for analysis in the Elemental Analyser.

Weighing of the bulk sample and sub sample were performed in the same room and with the two weight determinations (W_i and W_f), the analysed sample weights were corrected for conversion of $CaCO_3$ to $CaCl_2$.

A set of acetanilide standards (71.09% carbon and 10.36% nitrogen) was run at the start of each day to determine the K factors used to calculate the concentration of carbon and nitrogen. Empty tin cup and nickel sleeves were analysed to determine blank readings. Acetanilide was run as an unknown every 10 samples and at the end of each day.

The organic carbon content (%w/w) for the initial sample (OC_i) was calculated from the organic carbon content of the acidified sample (OC_f) as follows:

$$OC_i = OC_f \times (W_f / W_i)$$

Pooled standard deviation (s_p) for sample pairs is determined using the following formula:

$$s_p = \sqrt{\frac{\Sigma\ (c(1)-c(2))^2}{2n}}$$

where $c(1)$ and $c(2)$ are the concentrations of duplicate samples and n refers to the number of pairs

Special cleaning procedures for utensils and equipment can be found in the Elemental Analyser's Manual of Operation. Method referenced from Iperen and Helder (1985).

Table 7. Sediment analysis quality checks.

Standard (Acetanilide) CHN response factors							
Response factors used to calibrate CHN analyzer							
Mean K-C factor (calculated); 21.83 July 6, 2000; 21.99 July 7, 2000							
Mean K-N factor (calculated); 7.94 July 6, 2000; 8.11 July 7, 2000							
K-C and K-N of Acetanilide standard run every 10 samples and at the end of day							
	6-Jul-00				July 7, 2000 w/ new reduction tube		
	K-C	**K-N**			**K-C**	**K-N**	
	21.74	7.85			21.79	7.94	
	21.77	7.92			21.82	7.8	
	21.66	7.81			21.81	7.9	
	21.72	7.9			22.04	8.21	
mean	21.72	7.87			22.65	8.23	
stdev	0.05	0.05		**mean**	22.022	8.016	
				stdev	0.37	0.19	
Acetanilide standard run as a sample (unknown)							
	%C	**%N**	*Acetanilide contains 71.09% C and 10.36% N				
	71.28	10.24					
	70.64	10.32					
	69.95	10					
	70.62	10.19					
mean	70.62	10.19					
stdev	0.54	0.14					

2.4.3 Moorings and Buoys

Sediment trap mooring AG99-24 was deployed in water 663 m deep and consisted of Aanderaa current meters RCM4, S/N 7922, at 74.6 m and RCM4, S/N 7914, at 635 m and a Honjo sediment trap at 445.3 m (Figure 15). See Table 8 for HONJO trap sampling schedule.

Station	AG99-24
Date/Time	September 4, 1999; 1910 GMT
Latitude	70 33 15 N
Longitude	122 54 34 W
Current meters	74.6 m; RCM4 S/N 7922
	635 m; RCM4 S/N 7914
Honjo sediment trap	445.3 m
Water Depth	663 m

Preservative

To prepare the preservative, 28 g of NaCl and 7 g of $HgCl_2$ were added to the premeasured jug and dissolved in 3.78 L seawater collected from the deployment site. Several hours were allowed for complete dissolution. The 250 mL polybottle was filled to the bottom on the neck with the preservative (270 mL). Bottles were placed on the carousel and filled to the top with seawater from a squeeze bottle collected on site at the intended depth of the trap.

Table 8. Sampling schedule for HONJO trap deployed during Arctic Mission 1999-24 at station AG99.

Event	Date	Time Zone	Sampling	Start	Finish	Cup #	Interval (days)	Interval mid-point
0	SETUP							
1	SETUP							
2	9/7/1999 0:00	CDT	start sampling cup#1	07-Sep-99	01-Oct-99	1	24	19-Sep-99
3	10/1/1999 0:00	CDT	start sampling cup#2	01-Oct-99	25-Oct-99	2	24	13-Oct-99
4	10/25/1999 0:00	CDT	start sampling cup#3	25-Oct-99	18-Nov-99	3	24	06-Nov-99
5	11/18/1999 0:00	CDT	start sampling cup#4	18-Nov-99	02-Jan-00	4	45	10-Dec-99
6	1/2/2000 0:00	CDT	start sampling cup#5	02-Jan-00	16-Feb-00	5	45	24-Jan-00
7	2/16/2000 0:00	CDT	start sampling cup#6	16-Feb-00	01-Apr-00	6	45	09-Mar-00
8	4/1/2000 0:00	CDT	start sampling cup#7	01-Apr-00	25-Apr-00	7	24	13-Apr-00
9	4/25/2000 0:00	CDT	start sampling cup#8	25-Apr-00	19-May-00	8	24	07-May-00
10	5/19/2000 0:00	CDT	start sampling cup#9	19-May-00	12-Jun-00	9	24	31-May-00
11	6/12/2000 0:00	CDT	start sampling cup#10	12-Jun-00	06-Jul-00	10	24	24-Jun-00
12	7/6/2000 0:00	CDT	start sampling cup#11	06-Jul-00	30-Jul-00	11	24	18-Jul-00
13	7/30/2000 0:00	CDT	start sampling cup#12	30-Jul-00	23-Aug-00	12	24	11-Aug-00
14	8/23/2000 0:00	CDT	start sampling cup#13	23-Aug-00	08-Sep-00	13	16	31-Aug-00
15	9/8/2000 0:00	CDT	finish sampling cup#13					

Sample bottles from 1999-2000 illustrating relative amounts of sediment collected.

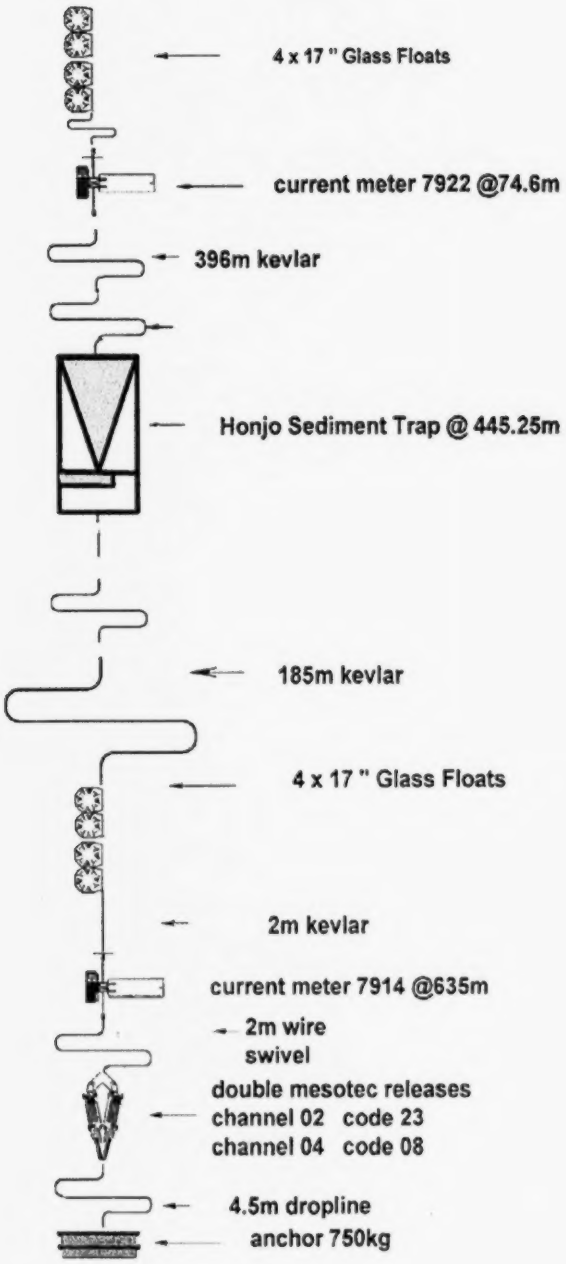


Figure 15. Sediment trap mooring diagram for AG99-24.

3. REFERENCES

Barwell-Clarke, J. and Whitney, F. 1996. Institute of Ocean Sciences Nutrient Methods and Analysis. *Can. Tech. Rep. Hydrogr. Ocean Sci.* 182:vi + 43 p.

Carpenter, J.H. 1965. The Chesapeake Bay Institute technique for the Winkler dissolved oxygen method. *Limnol. Oceanogr.* 10:141-3.

Epstein, S. and Mayeda, T. K. 1953. Variation of O^{18} content of waters from natural sources: *Geochimica et Cosmochimica Acta*. 4:213-224.

Falkner, K.K., MacDonald, R.W., Carmack, E.C. and Weingartner, T. 1994. The potential of barium as a tracer of Arctic water masses. p. 63-76. *In:* O.M. Johannessen, R.D. Muench and J.E. Overland [eds.]. The Polar Oceans and Their Role in Shaping the Global Environment: The Nansen Centennial Volume, AGU Geophys. Monograph Series, AGU Books, Washington, D.C.

Fofonoff, N.P. and Mallard, R.C. 1983. Algorithms for computation of fundamental properties of seawater. *UNESCO Technical Papers on Marine Science*. 44:141-143.

Horita, J., Wesolowski, D. and Cole, D. 1993. The activity-composition relationship of oxygen and hydrogen isotopes in aqueous salt solutions: I. Vapor-liquid water equilibration of single salt solutions from 50 to 100 °C. *Geochimica et Cosmochimica Acta*. 57:2797-2817.

Iperen, J. Van and Helder, W. 1985. A Method for the Determination of Organic Carbon in Calcareous Marine Sediments. *Marine Geology*. 64:179-187.

Lewis, E.L. and Perkin, R.G. 1981. The Practical Salinity Scale 1978: conversion of existing data. *Deep Sea Res.* 28 A:307-328.

Minkley, B. and Chase, G. 1997. Dissolved Oxygen Determination Methods and Procedures. Institute of Ocean Sciences, July 30, 1997. Internal Document.

O'Neil, J.R., Adami, L.H. and Epstein, S. 1975. Revised value for the ^{18}O fractionation factor between CO_2 and water at 25 °C. *J. Res. U.S. Geol. Surv.* 3:623-624.

Pearson, R. 1995. Institute of Ocean Sciences CTD Data Processing Guide, Theories and Procedures for CTD Data Processing. Institute of Ocean Sciences, October 15, 1995. Internal Document.

Sofer, Z.a.G.J.R. 1972. Activities and concentrations of oxygen-18 in concentrated aqueous salt solutions: analytical and geochemical implications: *Earth Planet. Sci. Lett.*15:232-238.

4. APPENDIX

4.1 SCIENCE PARTICIPANTS

Table 9. Science Team

Name	Affiliation	Responsibility
Fiona McLaughlin	IOS	Chief Scientist
Gilles Arfeuille	IOS	CTD
Ed Carmack	IOS	CTD
Nes Sutherland	IOS	CFC analysis
Mary O'Brien	IOS	Oxygen analysis
Janet Barwell-Clarke	IOS	Nutrient analysis
Darren Tuele	IOS	Boxcore and zooplankton sampling; mooring deployment

4.2 LOCATION OF SCIENCE STATIONS

Table 10. Mission 1999-24 CTD/Rosette cast locations.

Station	Guildline Cast #	Date	Latitude (°N)	Longitude (°W)	Water Depth (m)	Boatdeck activity	Foredeck activities
PS3	NA	Aug-25-99	71.12	97.22	150	CTD	
FT1	14	Aug-26-99	71.96	96.46	121	CTD/Rosette	
FT2	15	Aug-26-99	71.96	96.37	376	CTD	
FT3	18	Aug-26-99	71.96	96.22	463	CTD/Rosette	Boxcore and zooplankton tow
FT3	19	Aug-26-99	71.96	96.21	465	CTD/Rosette	
FT4	21	Aug-26-99	71.96	95.83	430	CTD/Rosette	
FT5	22	Aug-26-99	71.96	95.50	197	CTD	
FT6	23	Aug-26-99	71.96	95.34	155	CTD	
FT7	25	Aug-26-99	71.96	95.25	137	CTD/Rosette	
BS1	34	Aug-27-99	71.97	95.05	371	CTD/Rosette	
BS2	35	Aug-27-99	72.01	94.60	145	CTD/Rosette	
BS3	37	Aug-27-99	71.99	94.37	94	CTD/Rosette	
PS1	38	Aug-27-99	71.75	96.15	404	CTD	
JR1	39	Aug-28-99	70.25	97.08	104	CTD/Rosette	
JR2	40	Aug-28-99	70.25	97.02	98	CTD	
JR3	41	Aug-28-99	70.25	96.94	98	CTD	
JR4	43	Aug-28-99	70.25	96.88	103	CTD/Rosette	
JR5	44	Aug-28-99	70.25	96.82	96	CTD/Rosette	
JRL1	45	Aug-28-99	70.25	96.75	94	CTD	
JRL2	46	Aug-28-99	70.25	96.68	79	CTD	
JRL3	47	Aug-28-99	70.25	96.61	56	CTD	
JRL4	48	Aug-28-99	70.25	96.60	39	CTD/Bucket	
JR6	49	Aug-28-99	70.16	97.33	78	CTD/Rosette	
JR7	50	Aug-28-99	70.03	97.65	36	CTD	
QM1	51	Aug-30-99	68.29	100.63	79	CTD	

Station	Guildline Cast #	Date	Latitude (°N)	Longitude (°W)	Water Depth (m)	Boatdeck activity	Foredeck activities
CC3	52	Aug-30-99	68.82	105.28	61	CTD/Rosette	
TP1	53	Sept-2-99	68.65	108.28	29	CTD/Rosette	
TP2	54	Sept-2-99	68.68	108.35	77	CTD	
TP3	55	Sept-2-99	68.73	108.44	125	CTD/Rosette	
TP4	56	Sept-2-99	68.78	108.53	118	CTD	
TP5	57	Sept-2-99	68.82	108.60	83	CTD/Rosette	
EI1	58	Sept-2-99	68.46	110.95	70	CTD/Rosette	
EI2	59	Sept-2-99	68.44	110.98	117	CTD	
EI3	60	Sept-2-99	68.44	111.03	146	CTD	
EI4	61	Sept-2-99	68.31	111.14	203	CTD	
EI5	62	Sept-2-99	68.27	111.20	209	CTD/Rosette	
EI6	63	Sept-2-99	68.14	111.25	118	CTD	
EI7	67	Sept-2-99	68.05	111.28	300	CTD/Rosette	
EI8	68	Sept-2-99	67.97	111.31	272	CTD	
EI9	69	Sept-2-99	67.90	111.33	397	CTD/Rosette	
EI10	70	Sept-2-99	67.87	111.29	176	CTD/Rosette	
EI11	71	Sept-2-99	67.85	111.25	81	CTD	
EI16	72	Sept-2-99	67.88	111.20	228	CTD	
EI17	74	Sept-2-99	67.89	111.18	243	CTD	
EI18	75	Sept-2-99	67.89	111.11	85	CTD	
CI1	76	Sept-3-99	68.82	113.71	27	CTD	
CI2	77	Sept-3-99	68.79	113.84	50	CTD	
CI3	78	Sept-3-99	68.76	114.06	47	CTD/Rosette	
CI4	80	Sept-3-99	68.73	114.17	43	CTD	
CI5	81	Sept-3-99	68.71	114.42	20	CTD	
CI5	82	Sept-3-99	68.71	114.42	20	CTD	
AG1	83	Sept-4-99	69.87	122.94	92	CTD/Rosette	
AG2	84	Sept-4-99	69.97	122.94	207	CTD	
AG3	86	Sept-4-99	70.04	122.93	290	CTD	
AG4	87	Sept-4-99	70.18	122.94	397	CTD/Rosette	
AG5	88	Sept-4-99	70.56	122.94	640	CTD	Mooring, Boxcore, Zooplankton
AG5	89	Sept-4-99	70.56	122.94	637	CTD/Rosette	
AG6	91	Sept-5-99	70.77	122.94	432	CTD	
AG7	92	Sept-5-99	70.92	122.93	458	CTD	
AG8	93	Sept-5-99	70.97	122.94	277	CTD	
AG8b	94	Sept-5-99	71.02	122.94	275	CTD	
AG9	95	Sept-5-99	71.05	122.98	211	CTD/Rosette	
AG10	96	Sept-5-99	71.07	122.95	144	CTD	
JB1	97	Sept-6-99	71.98	119.02	28	CTD/Rosette	
JB2	98	Sept-6-99	72.00	119.29	90	CTD	
JB3	99	Sept-6-99	72.04	119.57	118	CTD/Rosette	
JB4	100	Sept-6-99	72.06	119.86	92	CTD	
JB5	101	Sept-6-99	72.09	120.12	49	CTD/Rosette	
TY1	103	Sept-7-99	69.58	120.60	89	CTD	
CM1	104	Sept-9-99	67.84	115.15	28	CTD	
SC1	105	Sept-10-99	68.72	108.93	95	CTD	

Station	Guildline Cast #	Date	Latitude (°N)	Longitude (°W)	Water Depth (m)	Boatdeck activity	Foredeck activities
CC2	107	Sept-10-99	68.78	105.37	45	CTD	
CC1	108	Sept-11-99	68.77	105.43	33	CTD/Rosette	
CC4	110	Sept-11-99	68.86	105.22	68	CTD	
CC5	111	Sept-11-99	68.88	105.15	53	CTD	
JL1	112	Sept-11-99	68.74	101.34	39	CTD	
RG1	113	Sept-11-99	69.07	101.12	55	CTD	
RG2	114	Sept-11-99	69.04	100.87	63	CTD	
RG3	115	Sept-11-99	69.02	100.76	44	CTD	
AI1	117	Sept-12-99	69.39	100.33	50	CTD	
AI2	118	Sept-12-99	69.35	100.14	27	CTD	
CF1	119	Sept-12-99	70.02	98.39	100	CTD	
CF2	120	Sept-12-99	69.95	98.20	113	CTD	
CF3	121	Sept-12-99	69.93	98.10	89	CTD/Rosette	
CF4	122	Sept-12-99	69.91	98.07	34	CTD/Rosette	
RS1	123	Sept-14-99	68.72	94.98	59	CTD	
TEST1	124	Sept-19-99	69.50	122.00	20	CTD	
Auxiliary sampling :							
1. Lake sampling for methane							
1			67.65	108.00			
2			68.88	115.63			
3			69.41	120.88			

4.3 CTD CALIBRATION AND PROCESSING SUMMARY

4.3.1 Guildline CTD Calibration

Table 11. Calibration Information for Guildline CTD Model 8715, S/N 43825.

Sensor		Pre-Cruise		Post-Cruise	
Name	**Serial No.**	**Date**	**Location**	**Date**	**Location**
Pressure	113368			Feb 2000	IOS
Temperature	57915	June 1999	IOS	Feb 11, 2000	IOS
Conductivity	58814	June 1999	IOS		IOS

Table 12. Calibration Coefficients for Guildline CTD Model 8715, S/N 43825.

Channel Name	Formula Number	Coefficients	
		C1	C2
Temperature	10	.0104305	.9999472
Transmissometer	10	.001018911	.998756

4.3.2 Guildline CTD Processing Summary

Date of Cruise: 23 August 1999 – 8 September 1999
Processed by: Germaine Gatien
Date of Processing: 3 February 2000 – 26 May 2000
Number of original casts: 92
Number of casts processed: 86

Quality and Concerns

There were many problems with the temperature data. The problems appeared as shifted values, either single or in groups, and were probably associated with a malfunction of the Range/Suppression encoding of temperature by the A/D converter in the CTD. Each cast needed editing to remove such bad points.

Preliminary Steps

The data files (*.acq and *.hdr) were obtained. The Log Book was obtained and note was made of problems that occurred during the cruise. The cruise summary sheet and calibration sheet were completed. The consecutive numbers found in the log do not correspond to the event numbers and cast names. By matching times, station names, positions and depths a table (9924cast.xls) was prepared linking the two sets of numbers. There remains some slight doubt about cast 99240017.

The header summary, header check and cruise track plot were examined. Many errors were found in the headers and the following corrections were made:

- wrong times for casts #14 to 50. The time is stated to be UTC but is not; the CTD log was used to correct the times.
- wrong positions for casts 31-33, 37, 54-57,70-74, 69, 109, 110.
- no header files for casts 46 and 86; headers were created by copying other headers and editing the positions, times etc. to match the CTD log.
- wrong station names for casts 61-63.
- format error in depth for cast 76.

Analysis of the pressure calibration and checks for hysteresis was hampered by the lack of zero reference pressures. The CTD was apparently turned on and off in the water. The CTD was held at the surface for some time for equilibration and a few data points were found when the CTD came very close to the surface, judging by the near-zero conductivity. There were also a few casts where near-zero conductivity values were found in the upcasts. For this cruise these near-surface downcasts had pressures of about -0.1 db and upcasts of about -0.4 db. The surface check for all casts after pressure spikes were removed found an average of 0.5 db, but the CTD sensors were probably about one meter below the surface when these values were recorded. There do not appear to be large problems with the pressure in either absolute value or hysteresis, but it is likely that the pressures are low so a recalibration was done to increase pressures by 0.5 db. The pressures should be considered to be within ±0.5 db.

Conversion

The data was converted using the IOS SHELL program ACQCONV. There was no useful data for casts 24,30,31,32,33.

Calibration

Pre-cruise and post-cruise calibrations were available for the Guildline CTD temperature, pre-cruise calibrations for conductivity and post-cruise calibrations for pressure, see Table 9.

VIEW EDIT

The calibrated data was full of spikes. A first attempt at using SIMPLE DESPIKE proved unsatisfactory, producing large steps in the data. These arose because very steep natural gradients in C and T in the seasonal pycnocline could not be distinguished automatically from erroneous data spikes.

VIEW EDIT was used to clean pressure, temperature and conductivity channels. Auto-despiking removed some of the bad data including most problems in conductivity. However, the temperature record was corrupted by bad points that tended to come in small groups where the sensor seemed to get stuck for a few records (typically 5 to 10 points); these had to be interpolated individually in a very time-consuming process.

Following VIEW EDIT the files were put through CLEAN to update the headers and then DERIVED QUANTITIES was used to recalculate salinity.

Several runs were sometimes required for this process. Plots of T, S, P and C versus record number were produced to determine when editing was satisfactory. All casts were run through Time Compensation and Delete and Page Plots produced to check editing as well. For many casts, further editing was needed so VIEW EDIT was used a second time (and occasionally a third time). There remained much bad data in surface records and some bad data at greater depths. These will be cleaned after the Time Compensation step by removing bad surface records and editing salinity for deeper noise.

Profiles of T and S (DQT files) were examined on screen to check that the up and down casts are similar. Casts #35, 91 and 92 were examined more closely since there were large differences. There were many spikes in the upcast data which was not edited. For casts #91 and 92 data files were checked and T and S values at 100 db were very similar in the upcast and downcast and the T-S curves reasonably similar at depth. For cast #35 there were large differences at 100 db but on a T-S diagram there is no significant difference; this cast was in a narrow channel.

Time Compensation

The following parameters were used for most casts:
Temp. probe Dist (m): 0.0000 Sample period (sec): 0.0400

Reverse

Casts #25, 74, 103, 107 and 110 were put through CLEAN to fix headers and then REVERSE because the upcast data was to be used.

DELETE

The following DELETE parameters were used:
Surface Record Removal: Last Press Min
Maximum Surface Pressure (relative): 20.00
Surface Swell Pressure Tolerance: 0.50
Pressure was not filtered.
Swells deleted. Warning message if pressure difference of 2.00
Drop rates < 0.30 m/s (calculated over 15 points) will be deleted
Sample interval = 0.04 seconds.

The Delete log was examined to check that the full depth was maintained and to examine warnings. All warnings referred to the surface, the bottom or the upcast.

CTD Edit

Page plots were prepared to guide editing of remaining problems. Records were removed or salinity edited in the top 20 m for casts: 18,23,39,41-47,49,51-54,56,57,60,69,71,72,75,77,78,83,88,89,99,100,104,107,110,112,114,117,118-122,124.

Salinity was edited below 20 m for casts: 19,22,25-37,61,67,70,74,84-87,91,92,96-98,101,103,108,111. Details of this editing are noted in each data file.

Comparison with Bottles

An SBE 19 was mounted with the Guildline and used to close the Niskin bottles on the rosette. Salinities from the rosette were matched with the values in the Guildline DQT files for pressures at which the temperature and salinity gradients were low (typically below 100 m) to study the stability and accuracy of the instrument calibration.

The deepest value (about 600 m) was rejected because the bottle salinity is lower than that at 550 m; neither the Guildline CTD nor the SeaBird CTD support the idea of salinity decreasing at that depth.

Averaging the 11 bottles from 200 m to 550 m, the Guildline CTD was found to give salinities high by 0.014 PSU. All differences were within ±0.007 PSU of that value. The data were recalibrated which lowered the salinities by 0.014 PSU and raised the pressure 0.5 db.

Other Intercomparisons

Repeat Casts – Casts 88 and 89 are at the same site. From 350 to 450 db the differences along gamma lines are less than the noise level in temperature and salinity

Casts from Amundsen Gulf were compared with each other and with historic deep values and show consistent and reasonable values at depth.

Bin Average

The following Bin Average values were used:
Bin channel = pressure
Averaging interval = 0.500
Minimum bin value = 0.000
Average value will be used
Interpolated values are NOT used for empty bins

Final Plots

Page plots were prepared using the edited data.

Remove Channels

The following channel was removed from all casts: Conductivity_Ratio

Produce Final Files

a) The final files were renamed *.ctd.
b) A cross-reference listing was produced.

CTD Cast Particulars

24 – No useful data; deleted.
25 – Use upcast
30,31,32,33 - No useful data; deleted.
46 – Header file missing. Dummy header file prepared with information from CTD Log.
74 – Use Upcast

86 – Header file missing. Dummy header file prepared with information from CTD Log.
103 – Use Upcast
107 – Use Upcast
110 – Use Upcast
124 – No CTD Log entry for this cast.

Bottom hits occurred during stations 23, 62, 69. The last bottom hit before the AG5-area stations, at station 69, had good salinity matching between bottle and ctd. The bottles and CTD data are from the upcast, after the hit, so a good match shows the sensors were not shifted by the bottom impact. The following (shallow) station does not show a bias either. It does not appear that the bottom hits were responsible for the temperature or salinity shift.

Records were removed or salinity edited in the top 20 m for casts:18, 23, 39, 41-47, 49, 51 to 54, 56, 57, 60, 69, 71, 72, 75, 77, 78, 83, 88, 89, 99, 100, 104, 107, 110, 112, 114, 117, 188 to 122, 124.
Salinity was edited below 20m for casts: 19, 22, 25 to 37, 61, 67, 70, 74, 84 to 87, 91, 92, 96 to 98, 101, 103, 108, 111.

Details of this editing are noted in each data file. Stations requiring CTD data for Niskin bottles to be chosen based on matching salinities: FT1, FT3, BS2, BS3-test, JR1, JR4, JRL4, EI9, CI1

AFM Files

Several *.AFM files were either lost or overwritten. This meant that a certain amount of sleuthing had to be done to determine which (if any) *.AFM file(s) corresponded to which SBE (*.HEX) files (see Table 13). Once this was done, the Seabird *.HEX files and the *.AFM files were renamed to correspond to the Guildline file cast numbers (IOSSHELL standard file names).

Next, the SBE program DATCNV.exe was used to produce *.CNV, *.BL, and *.ROS files (from corresponding Seabird *.AFM and *.HEX files). A program developed by Humfrey Melling (BOTVALUE.EXE) was then used to link the data contained in the *.ROS files to the processed Guildline data. The input to BOTVALUE.EXE is a file called botcasts.lis of the form:

Bottle.dat
99240019, 2.0
99240021, 1.692
etc;

where the first line specifies the name of the output file (bottle.dat) and subsequent lines give the file name of the cast (which should be identical for SBE and Gld) and the pressure offset error of the SBE. The pressure offset error was determined individually for each cast (using *.CNV files) and was defined as the pressure read by the SBE once a cast was over and the rosette was back on deck. The program also asks the user to specify the distance between the sensor and the rosette bottles (0.6 m in this case).

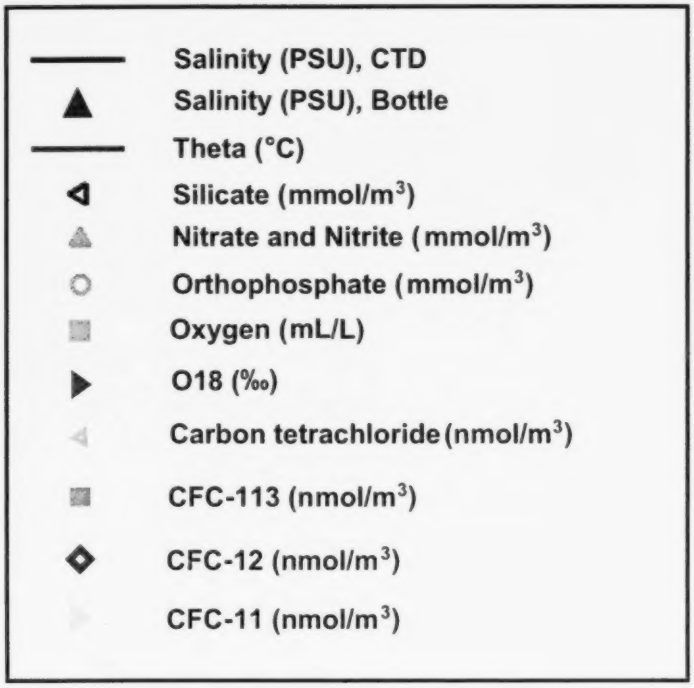
The final step was to use another program developed by Humfrey Melling that accounts for errors in trip temperature values due to the lag in the SBE sensor (SBETLAG.EXE). It is important when using this program to make sure that the channel 'Temperature:Cell' is used when computing salinity. The output of the program is a *.chk file, where the 5th column denotes corrections to temperature, and the 4th and 7th columns indicate computed before and after salinity values. In this case of the 9924 data, the corrections to temperature were not significant (difference ~ 10E-3) so the trip temperatures and salinity values obtained from BOTVALUE.EXE were left as is.

Table 13. Rosette stations and corresponding data files.

Station	SBE Hex/cast #	Corresponding .AFM file	Guildline CTD cast #	SBE pressure error
FT2	3	lost		
FT3	5	lost		
FT3	6	1	99240019.ctd	-2 ± 0.045
FT4	7	2,5,**6**	99240021.ctd	-1.692
FT7	10	7,8,9,**10**	99240025.ctd	-1.692
BS1	11	11	99240034.ctd	-2.183 ± 0.045
BS2	12	Lost		
BS3	13	12,**13**	99240037.ctd	-2.138 ± 0.089
JR5	19	15,16,17,18,**19**	99240044.ctd	-2 ± 0.045
JR6	24	24	99240049.ctd	-1.647 ± 0.045
CC3	27	27	99240052.ctd	-2.183 ± 0.045
TP1	28	28	99240053.ctd	-2 ± 0.045
TP3	30	30	99240055.ctd	-1.737 ± 0.045
TP5	32	32	99240057.ctd	-1.425 ± 0.089
EI1	33	33	99240058.ctd	-1.871 ± 0.090
EI5	37	37	99240062.ctd	-1.603
EI7	39	39	99240067.ctd	-1.559 ± 0.045
EI9	41	41	99240069.ctd	no .cnv file
EI10	42	42	99240070.ctd	-1.425 ± 0.089
CI3	49	49	99240078.ctd	-1.781 ± 0.090
AG1	52	52	99240083.ctd	-1.96 ± 0.089
AG4	55	55	99240087.ctd	-1.826 ± 0.45
AG5	56	Lost		
AG5	57	57	99240089.ctd	-1.425 ± 0.089
AG9	62	62	99240095.ctd	-1.736 ± 0.045
JB1	64	64	99240097.ctd	-2.227 ± 0.089
JB3	66	66	99240099.ctd	-2 ± 0.045
JB5	68	68	99240101.ctd	-2.138 ± 0.089

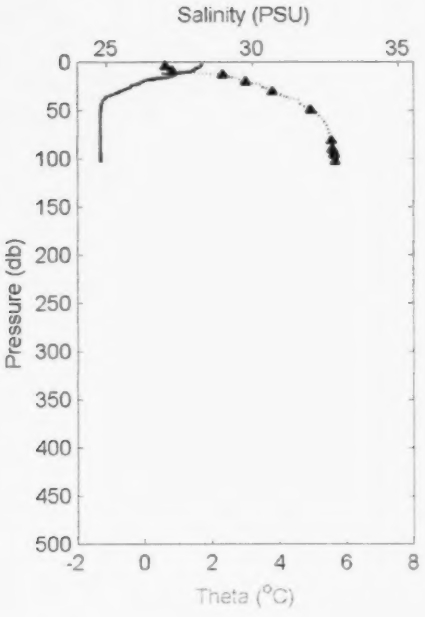
4.4 INDIVIDUAL STATION PLOTS

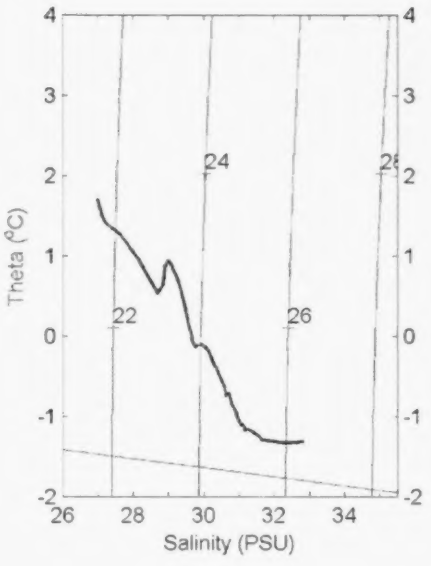
The following section contains data plots for each CTD cast taken on Cruise #1999-24. See below for property legend for the individual station plots.

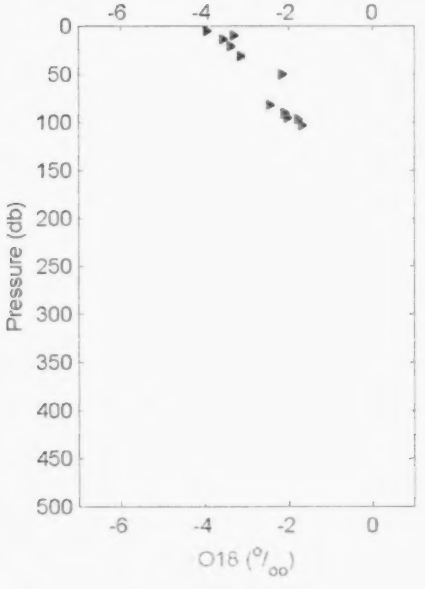


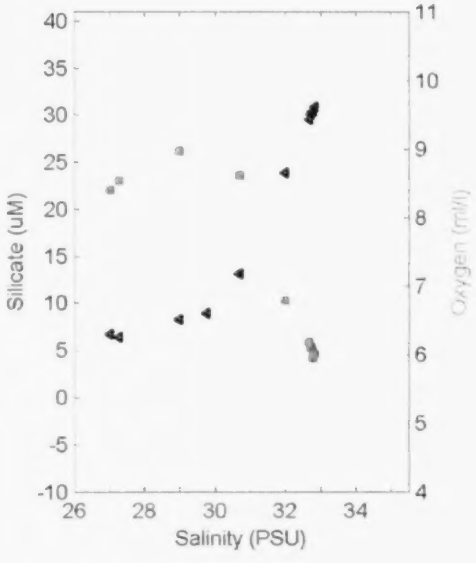
4.4.1 CTD/Rosette

1999-24: Cast 14 Station FT1

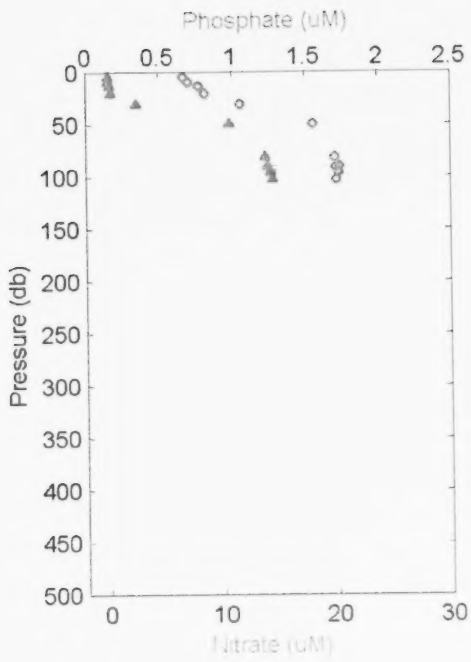


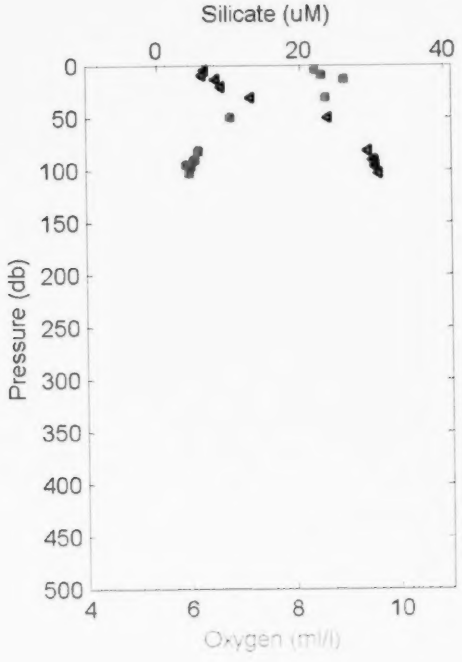


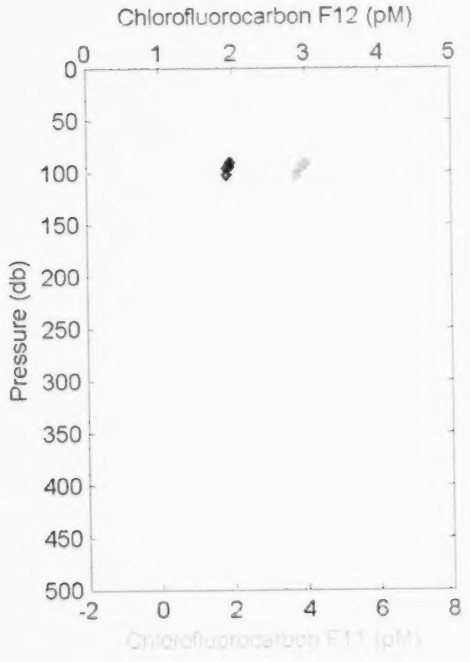


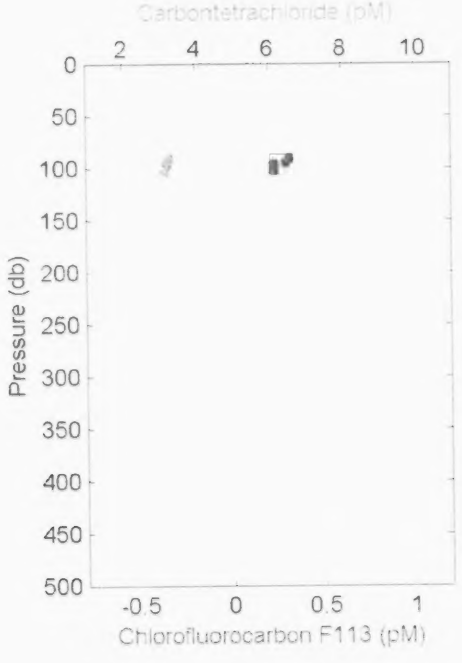


1999-24: Cast 14 Station FT1

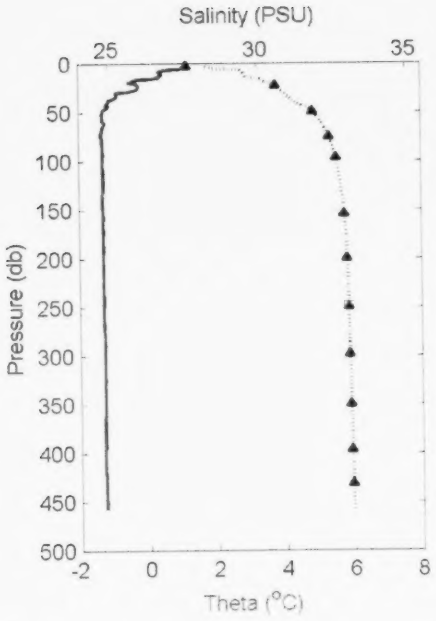


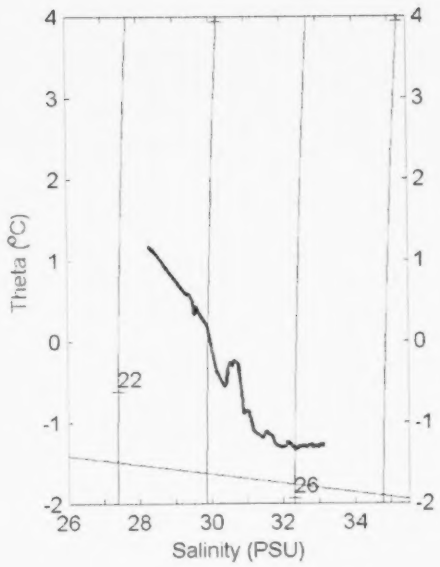


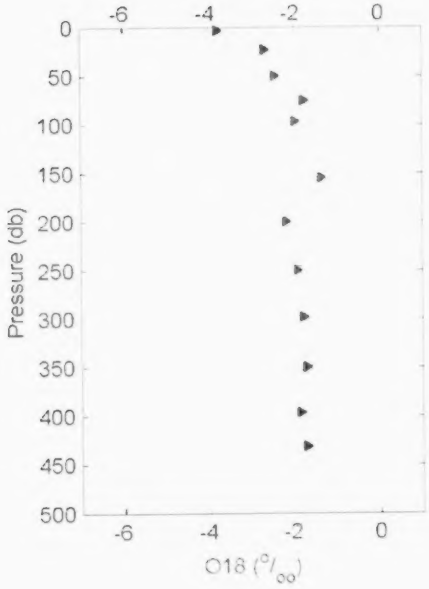


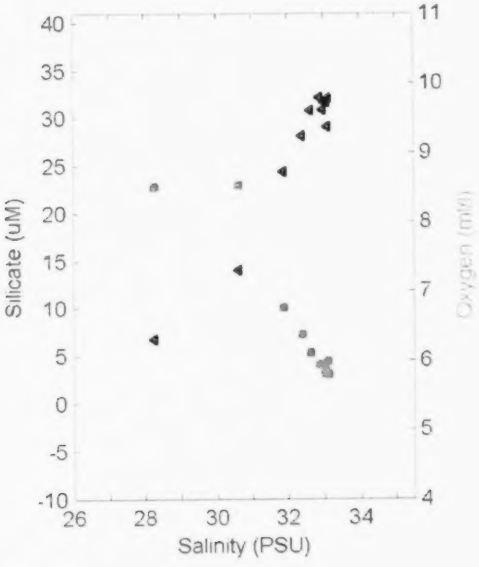


1999-24: Cast 18 Station FT3

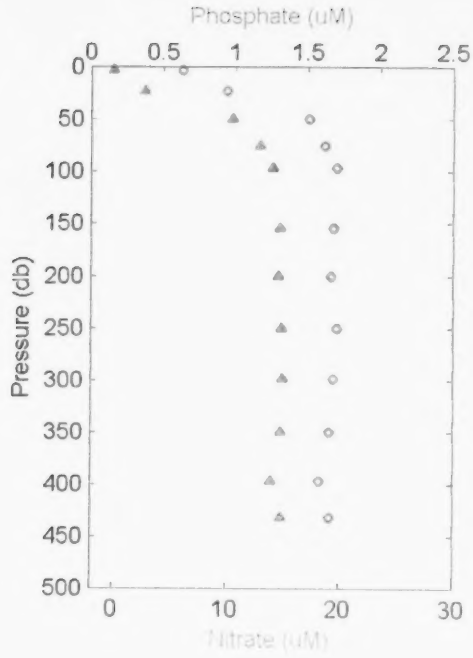


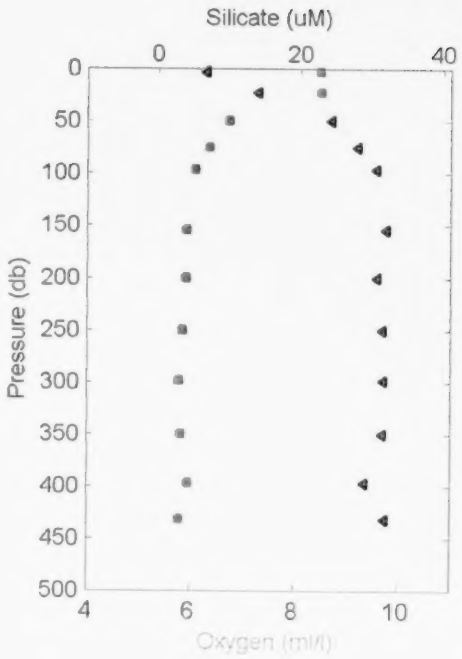


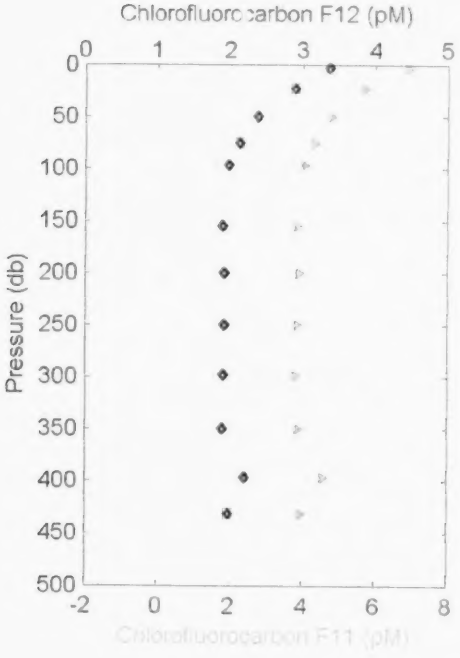


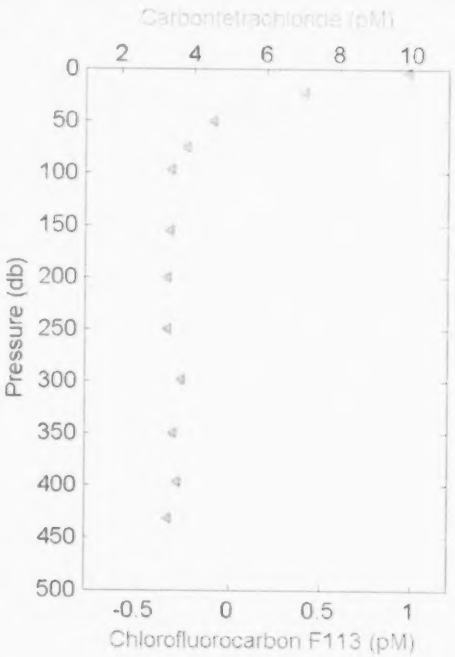


1999-24: Cast 18 Station FT3

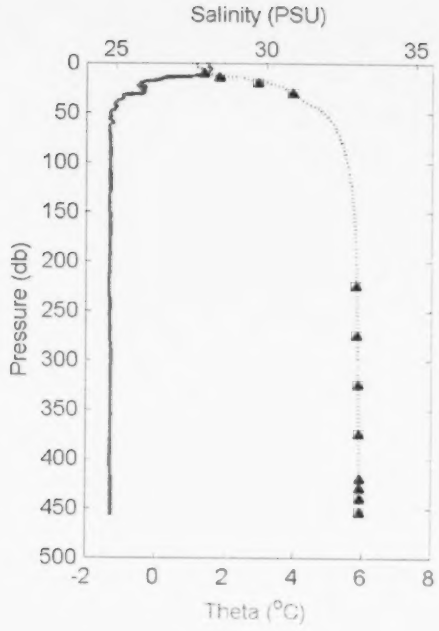


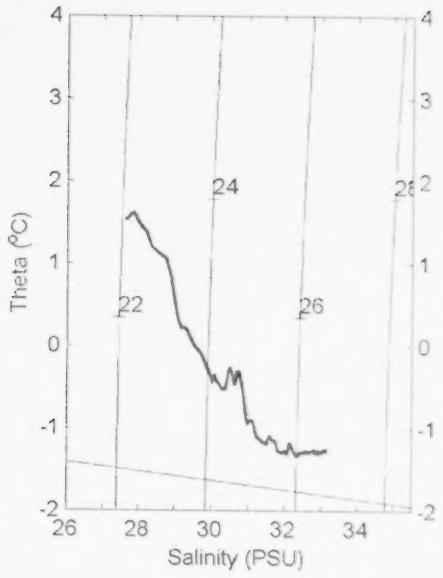


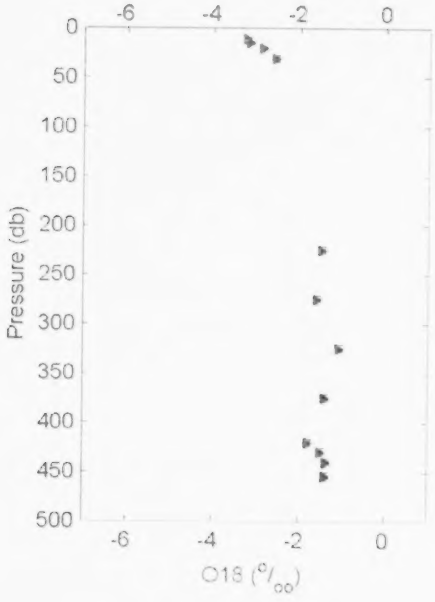


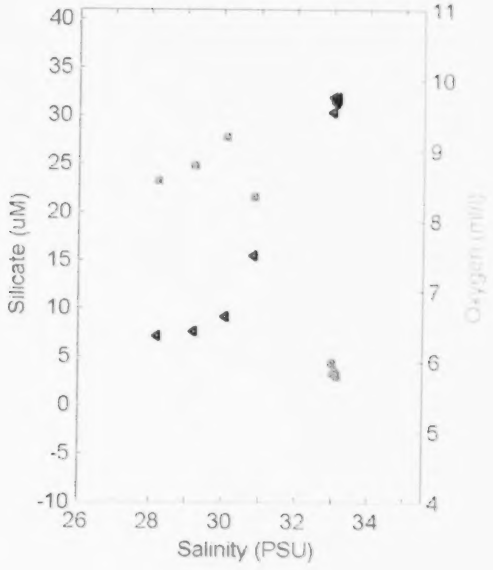


1999-24: Cast 19 Station FT3

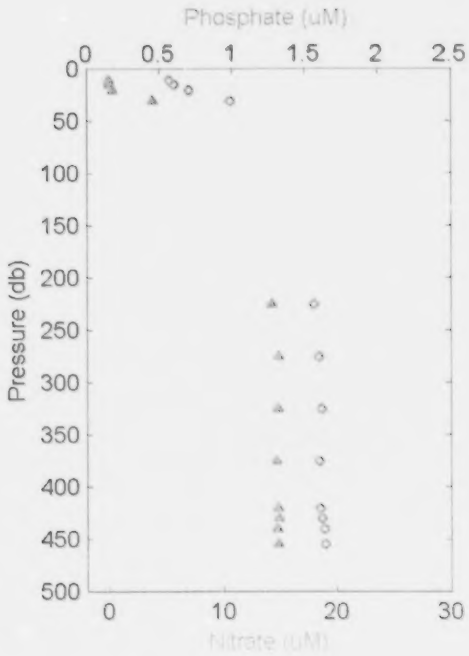


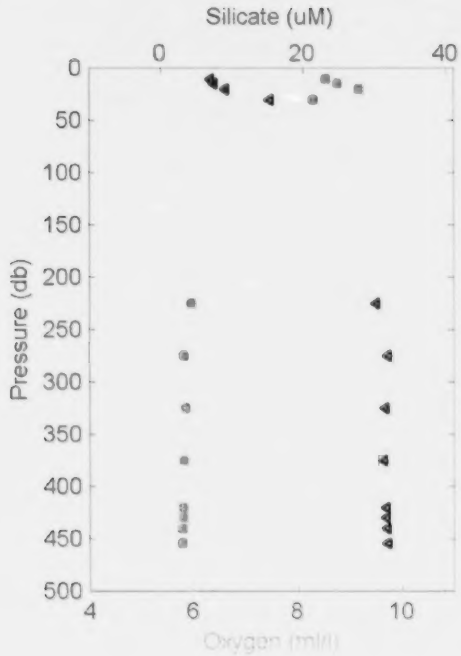


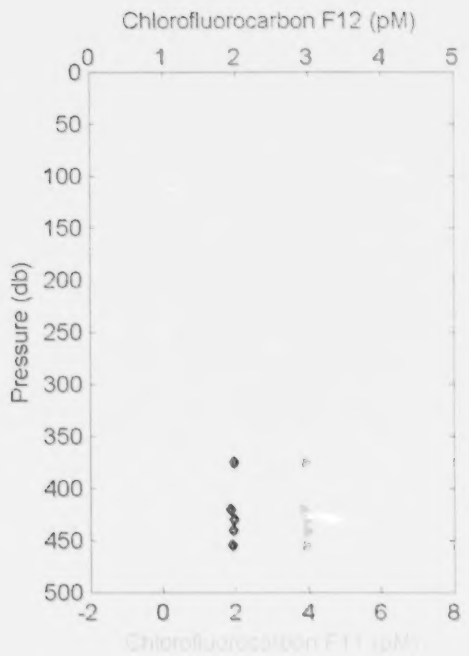


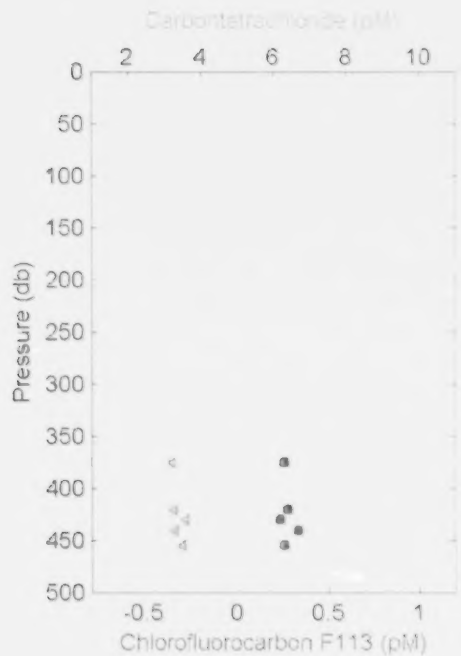


1999-24: Cast 19 Station FT3

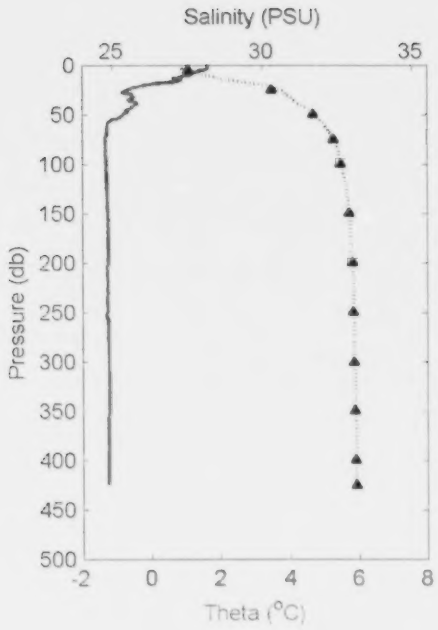


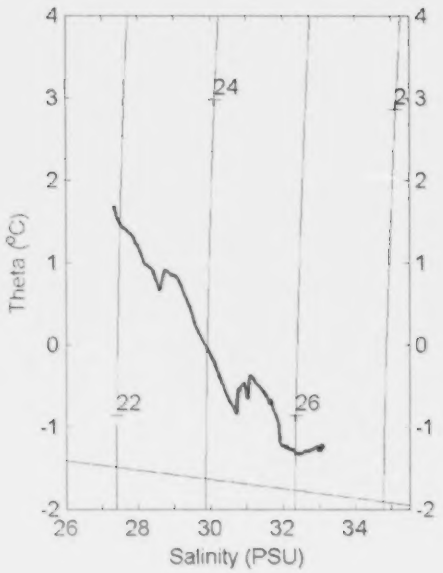


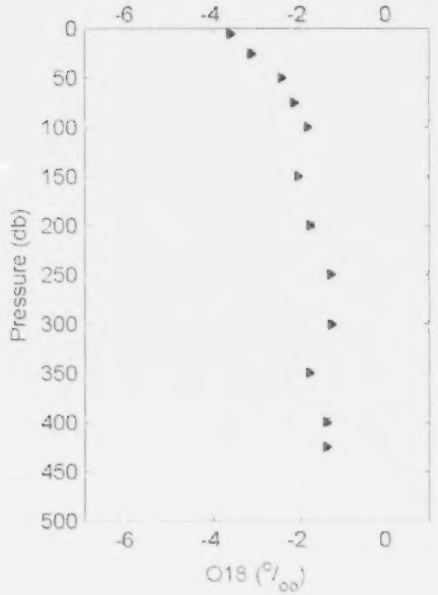


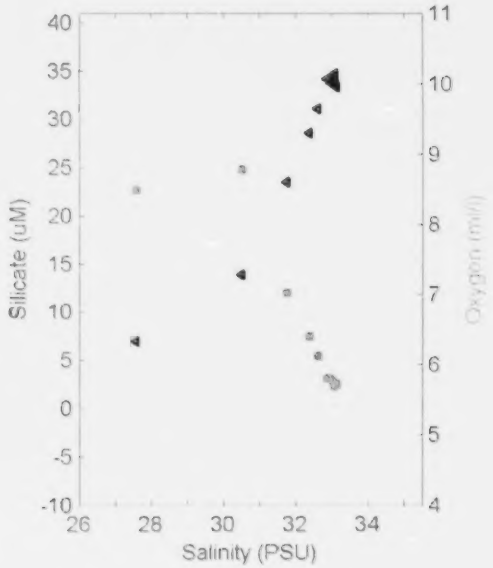


1999-24: Cast 21 Station FT4

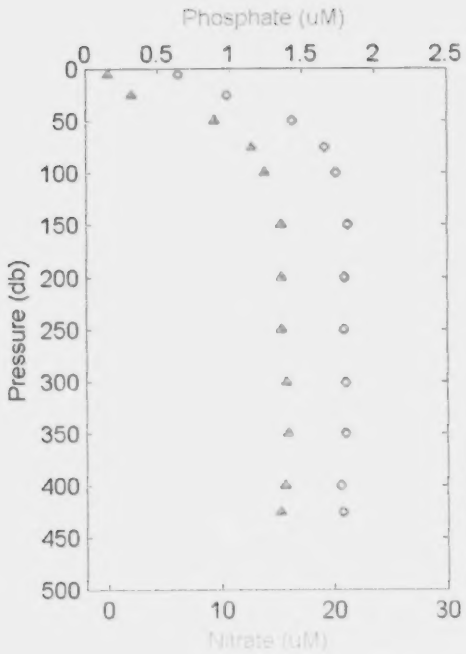


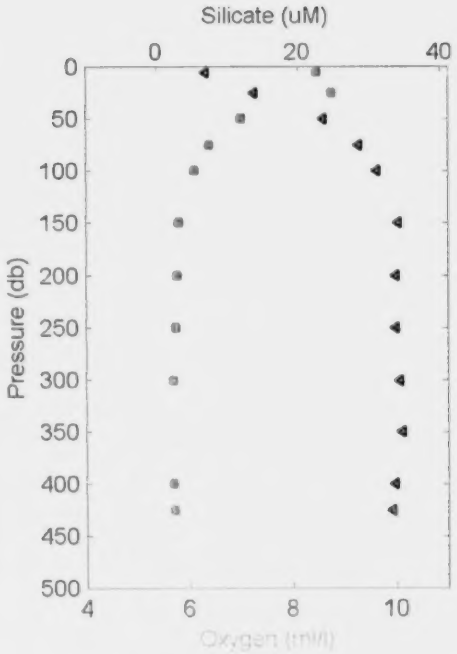


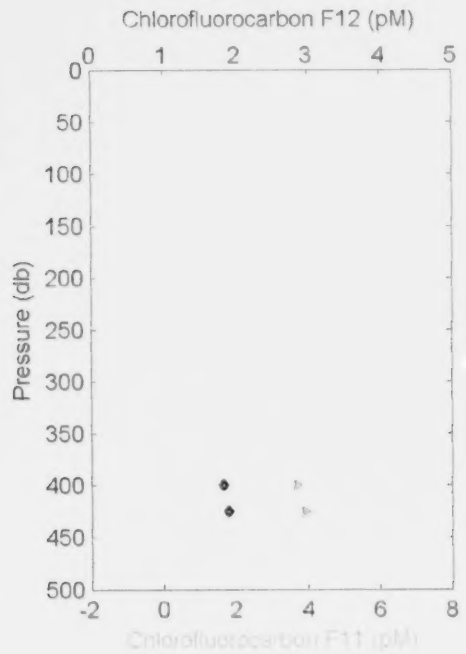


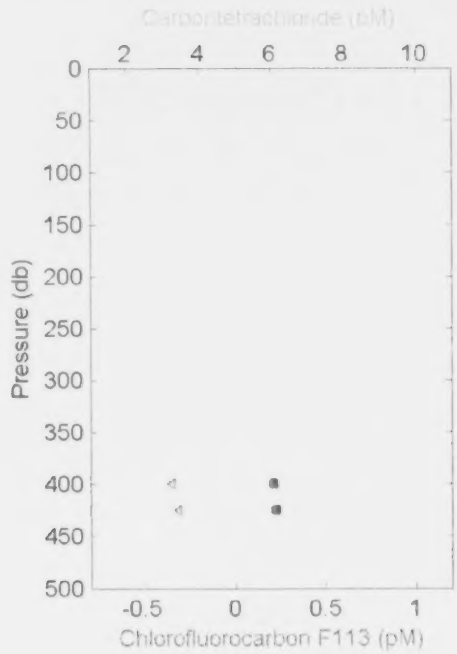


1999-24: Cast 21 Station FT4

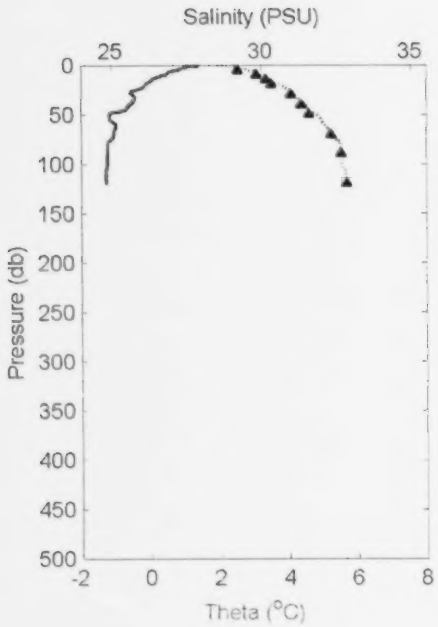


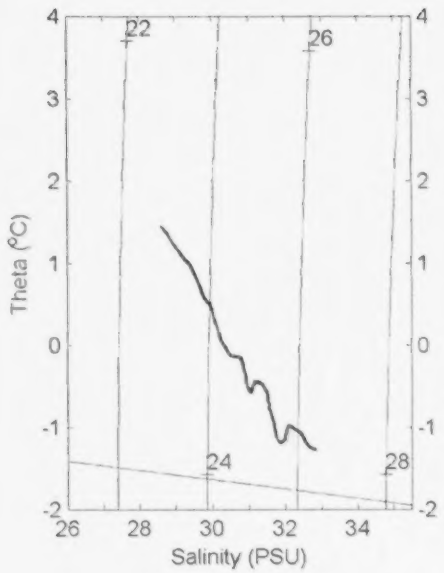


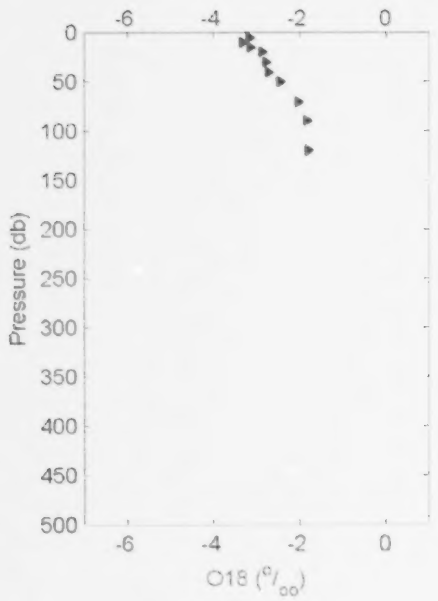


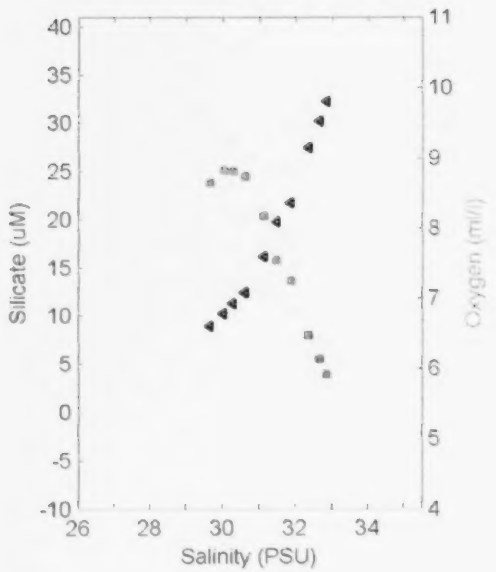


1999-24: Cast 25 Station FT7

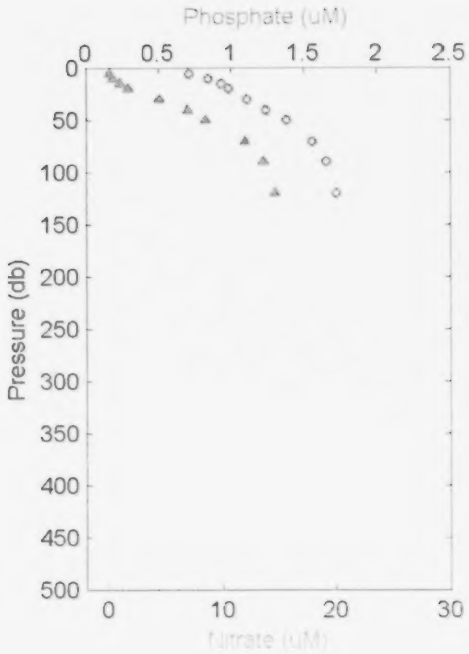


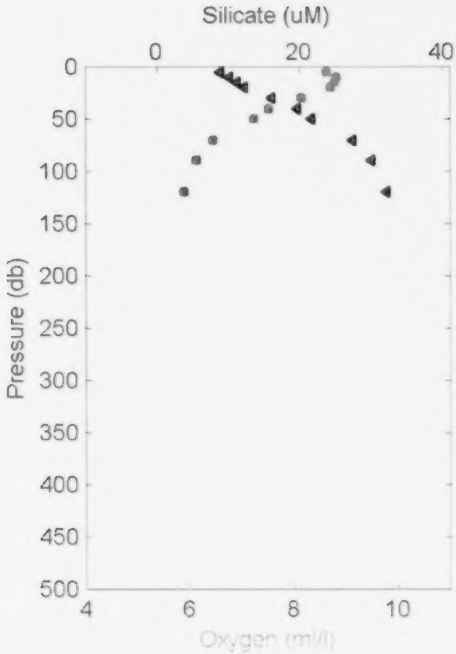


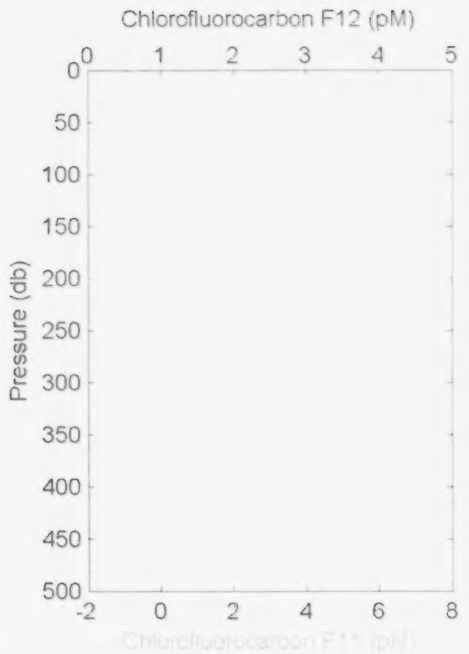


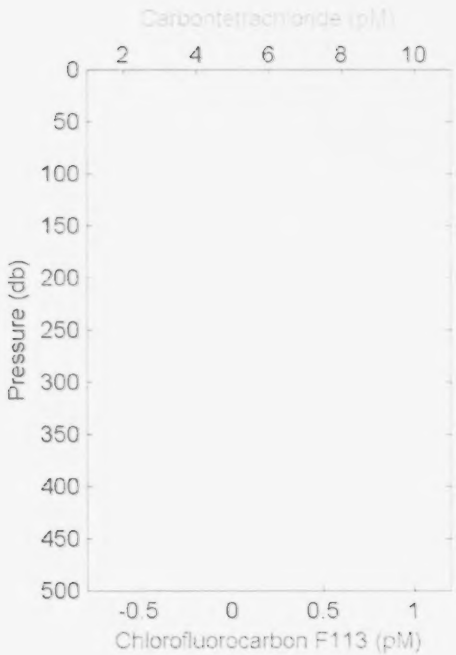


1999-24: Cast 25 Station FT7

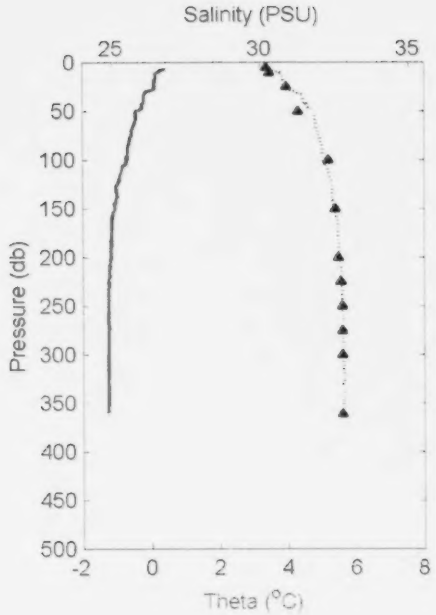


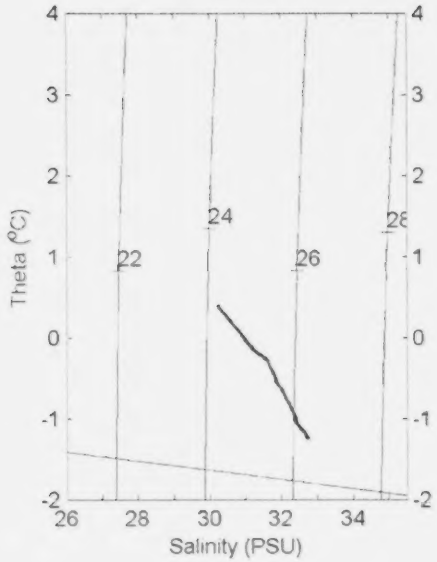


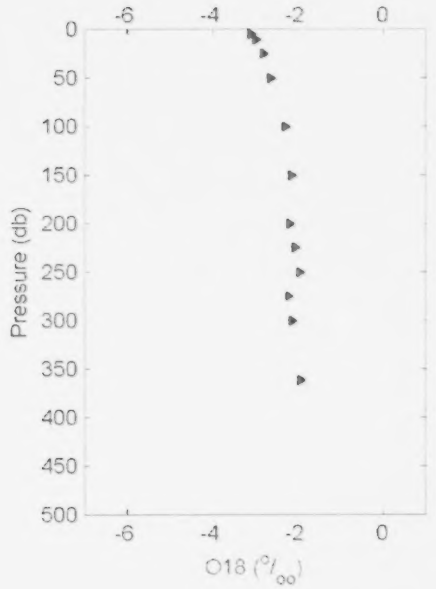


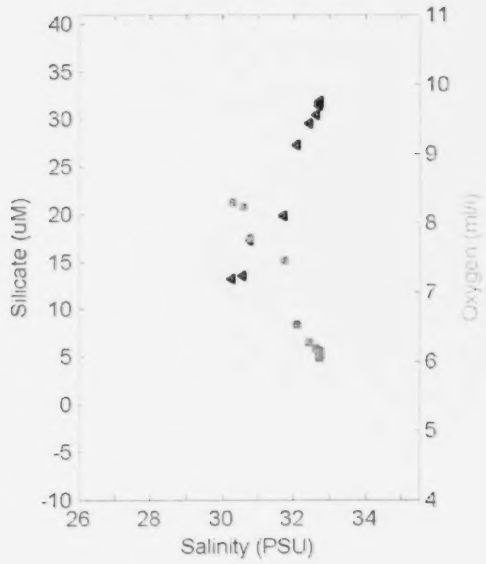


1999-24: Cast 34 Station BS1

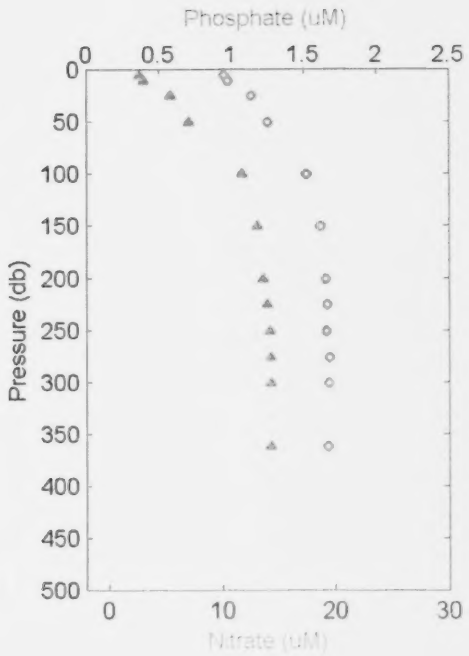


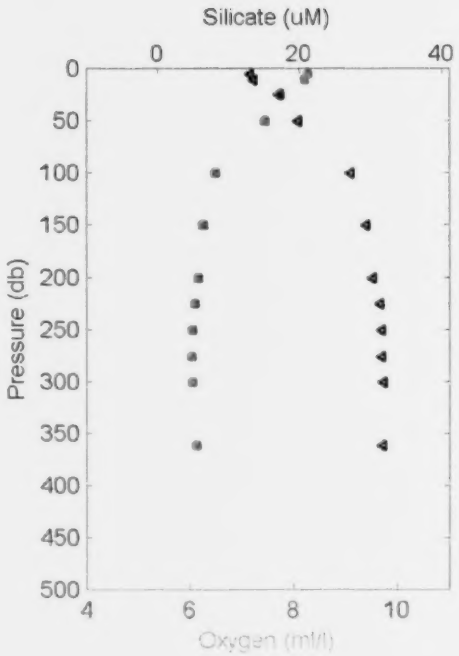


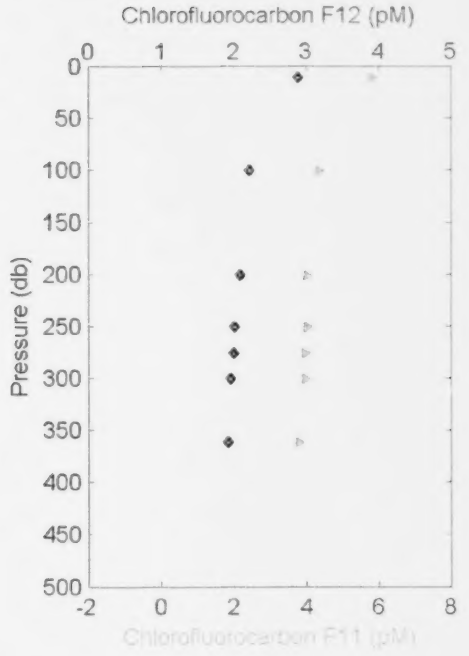


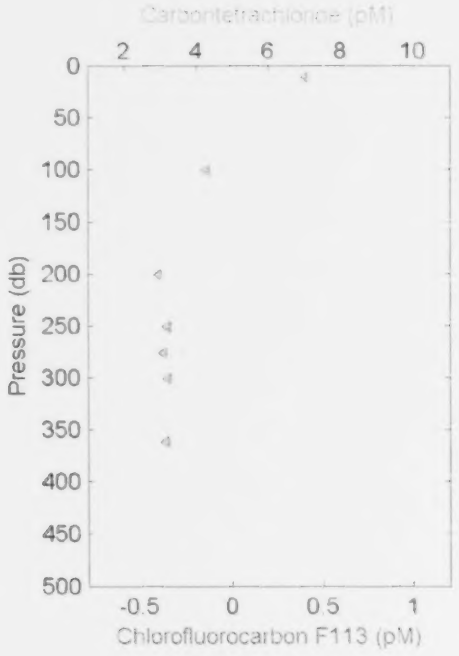


1999-24: Cast 34 Station BS1

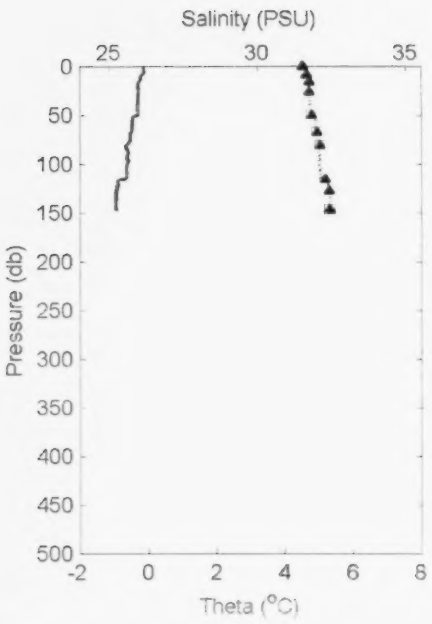


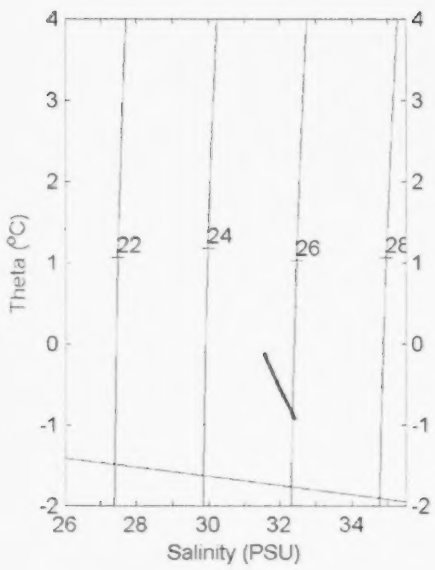


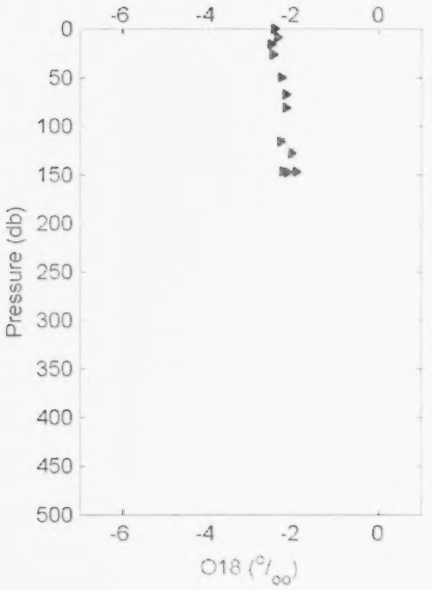


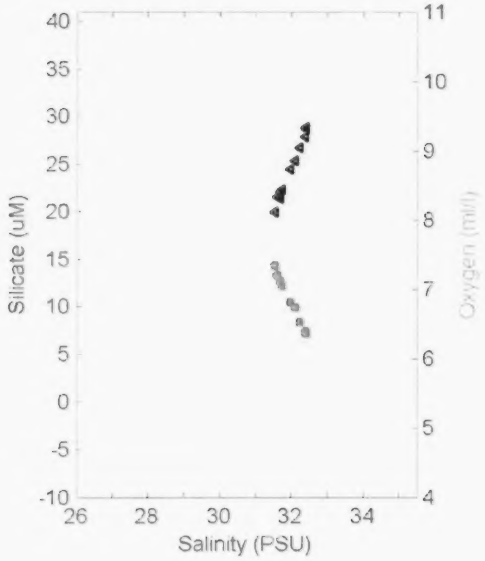


1999-24: Cast 35 Station BS2

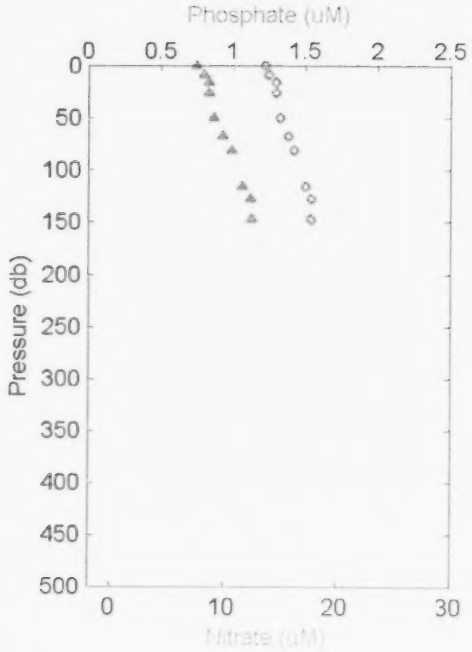


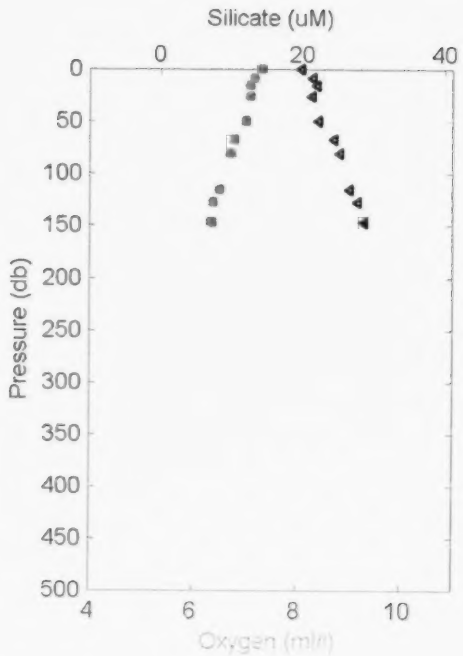


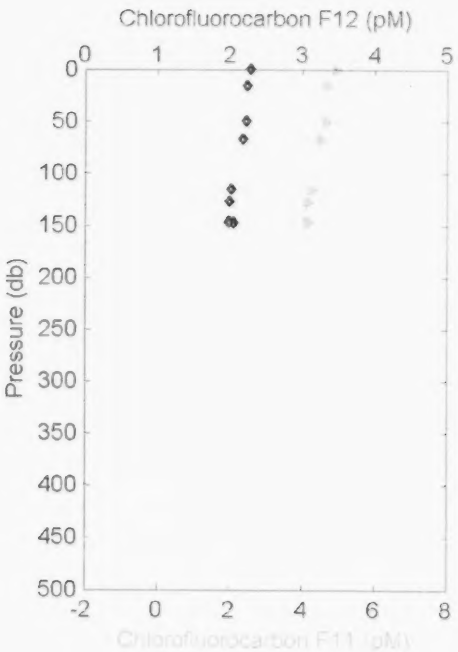


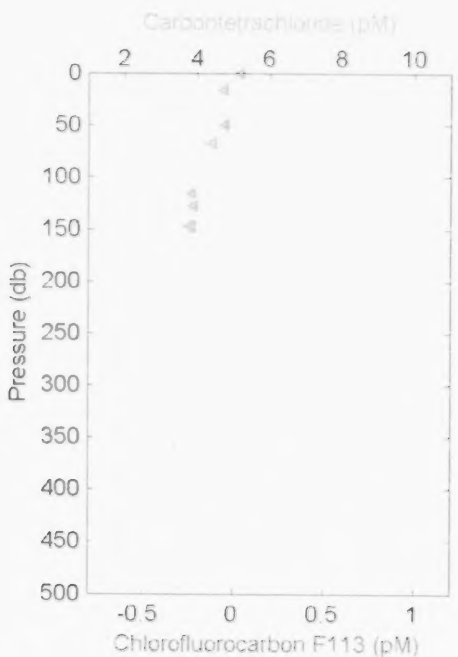


1999-24: Cast 35 Station BS2

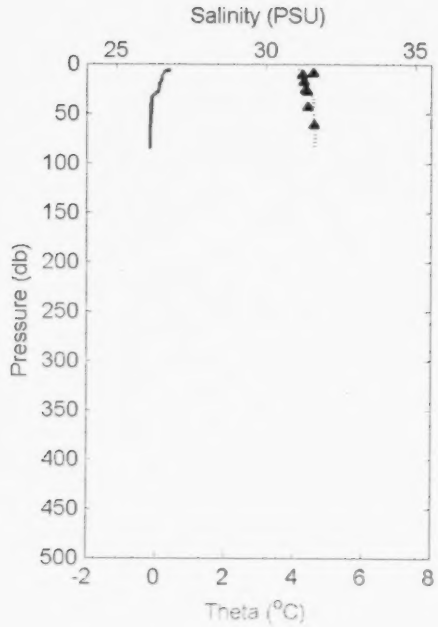


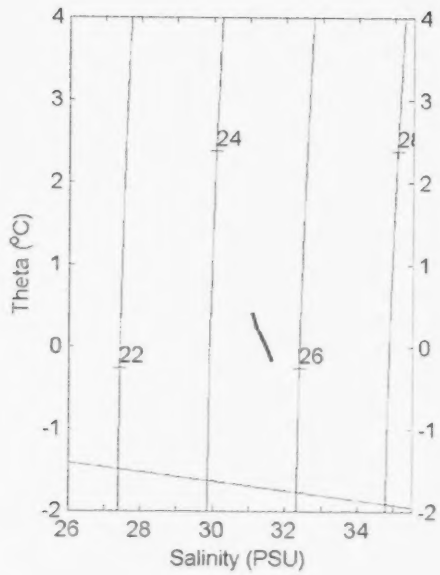


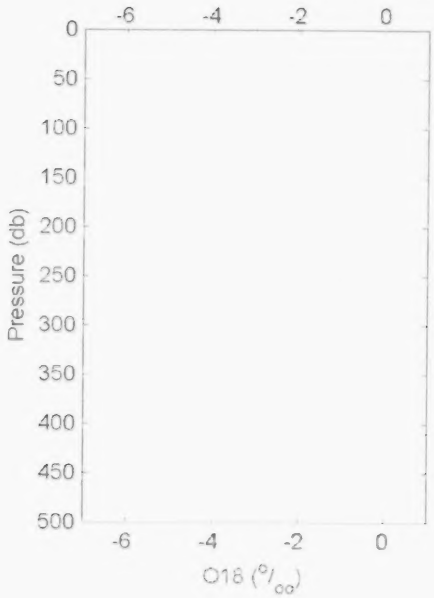


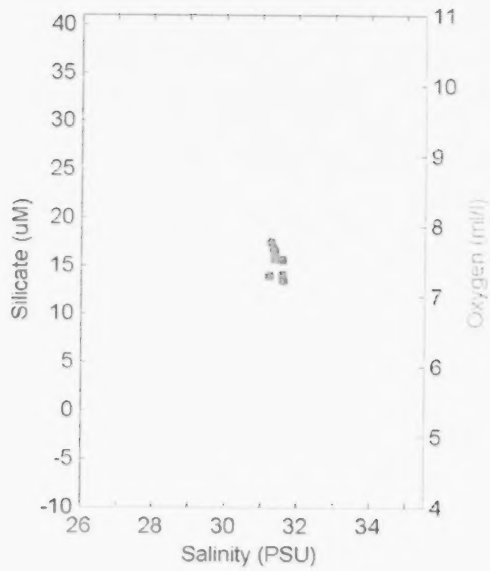


1999-24: Cast 37 Station BS3

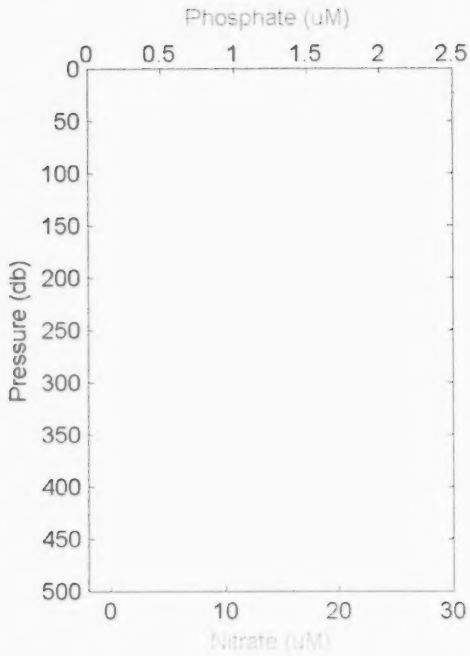


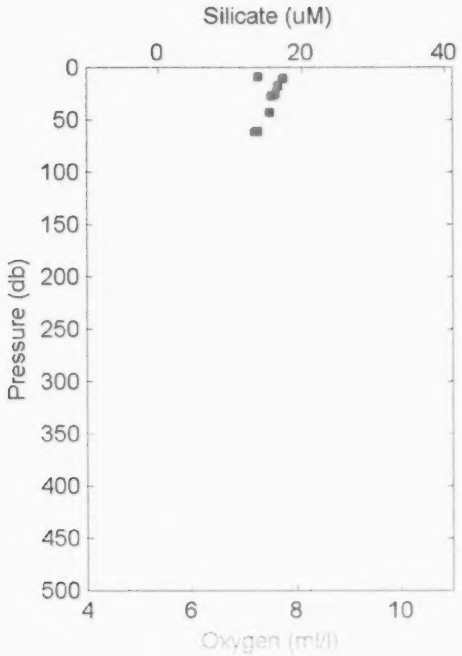


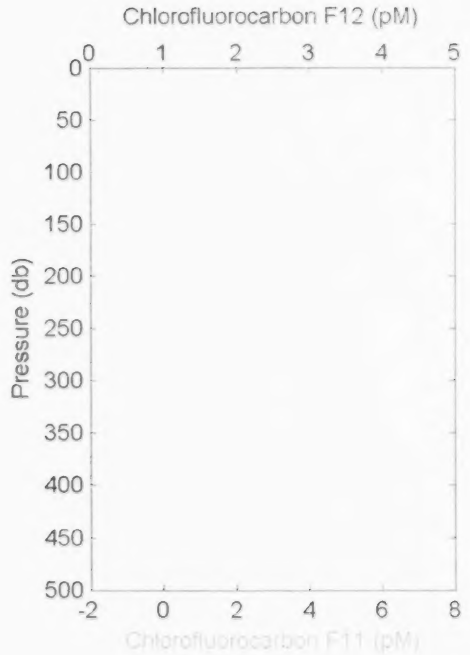


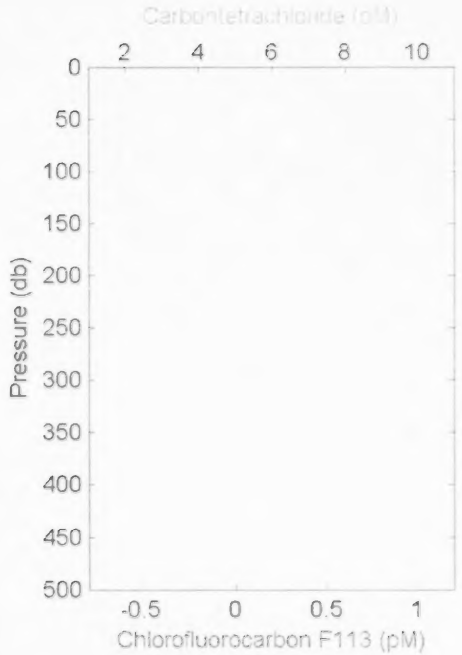


1999-24: Cast 37 Station BS3

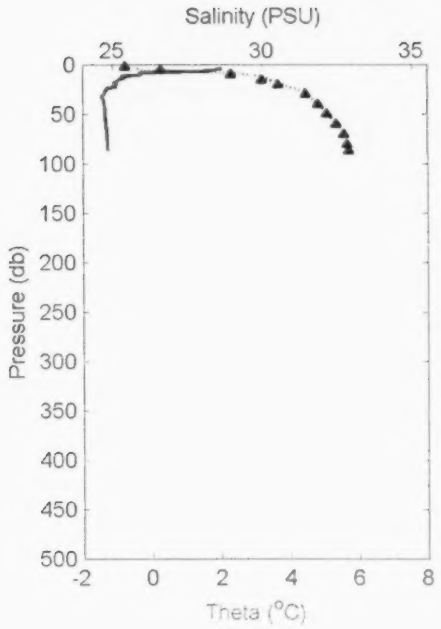


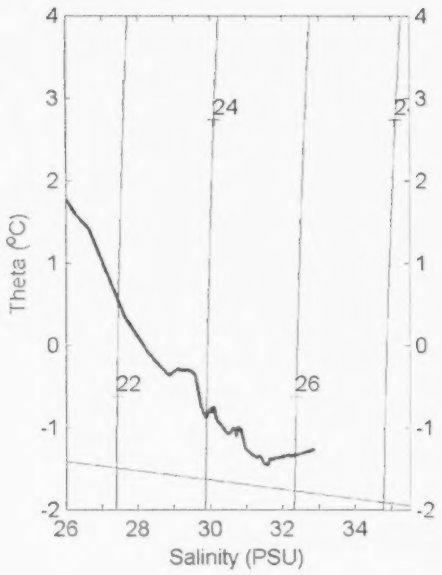


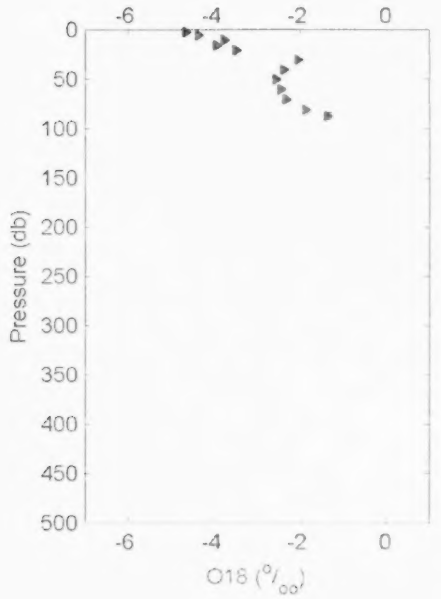


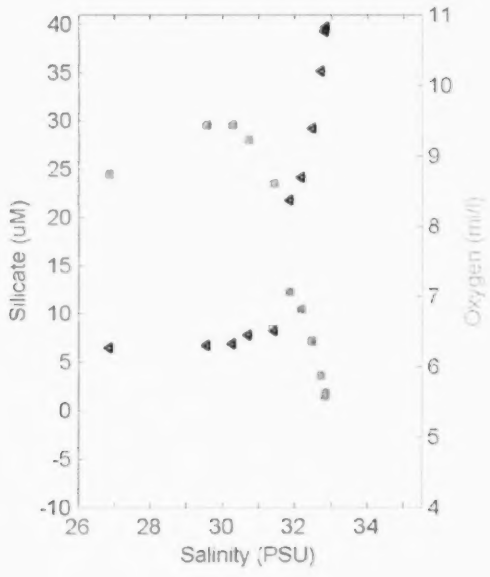


1999-24: Cast 44 Station JR5

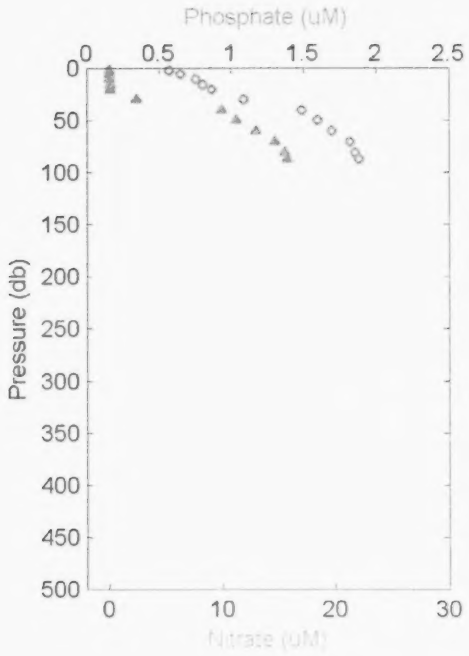


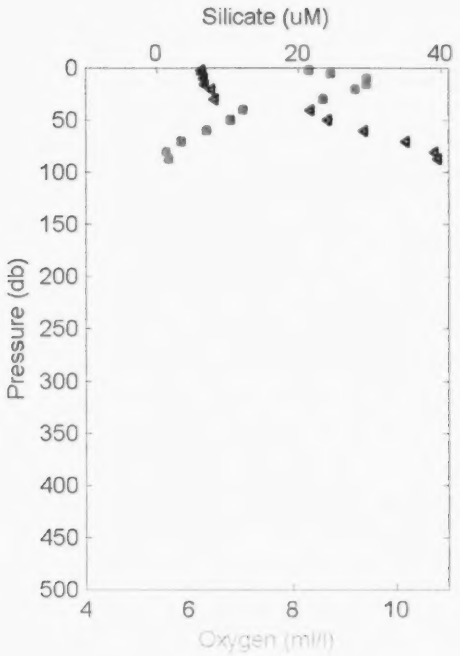


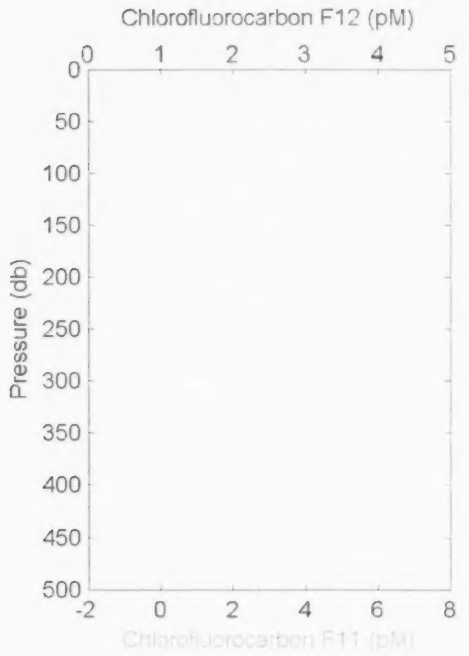


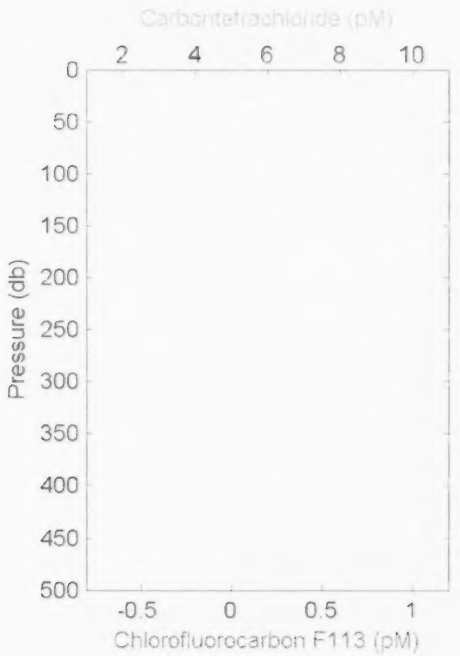


1999-24: Cast 44 Station JR5

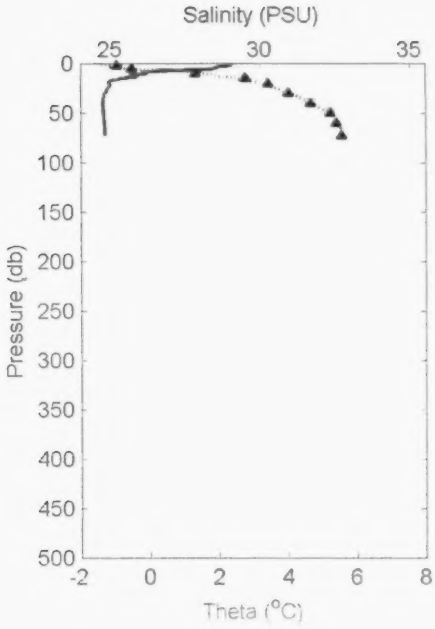


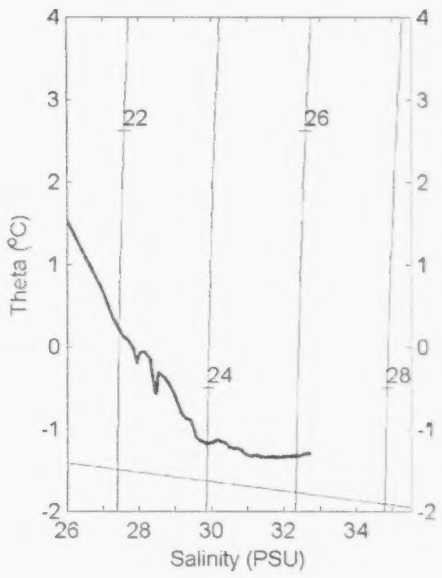


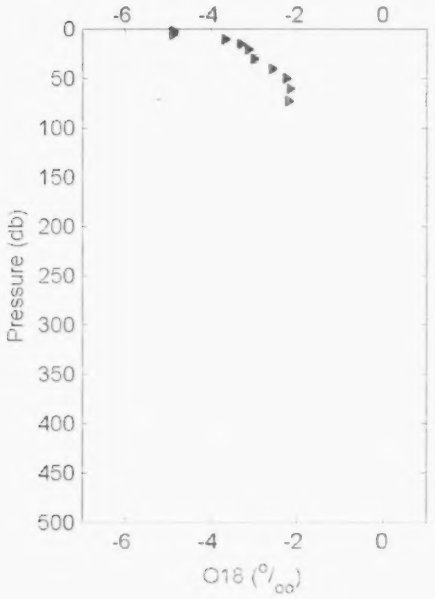


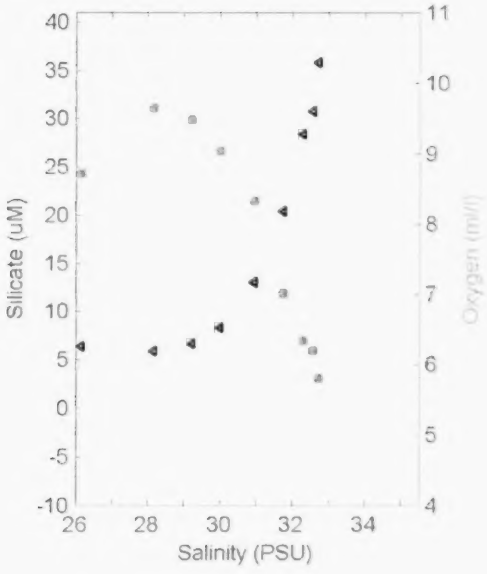


1999-24: Cast 49 Station JR6

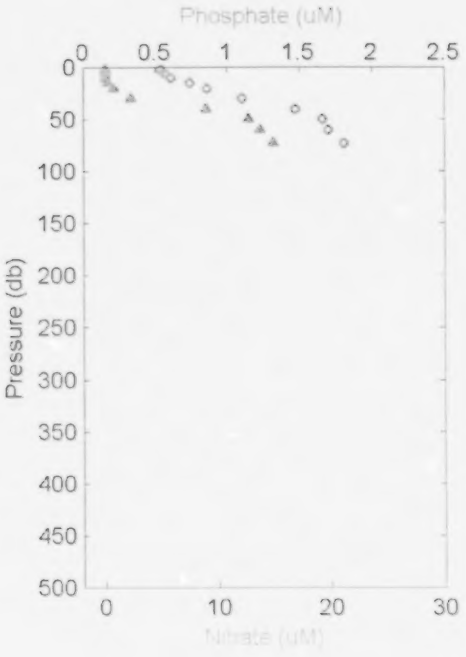


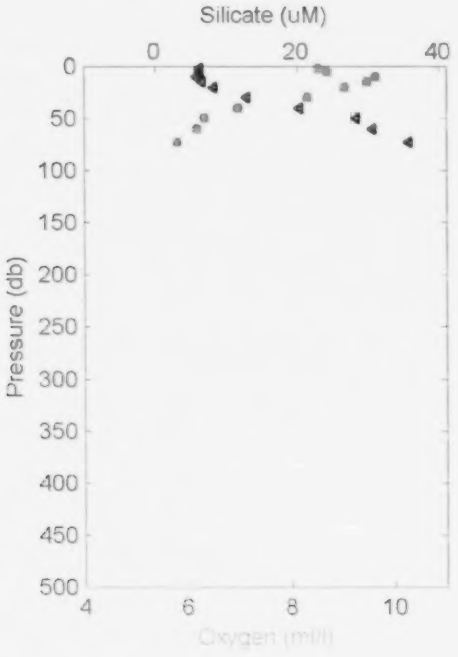


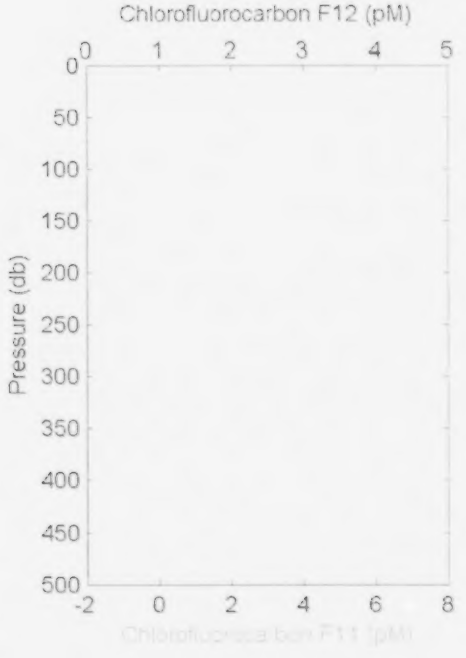


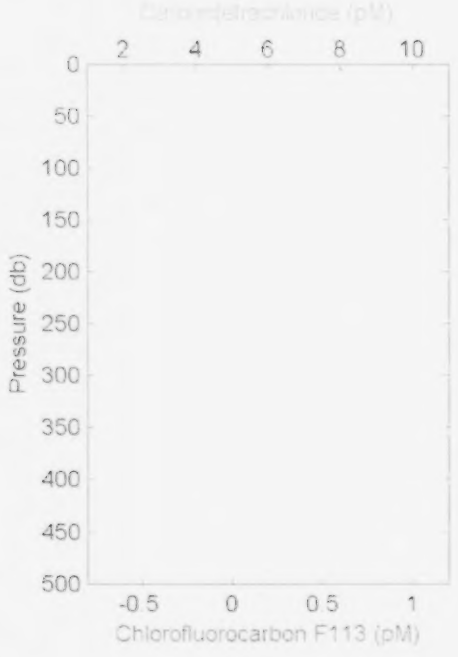


1999-24: Cast 49 Station JR6

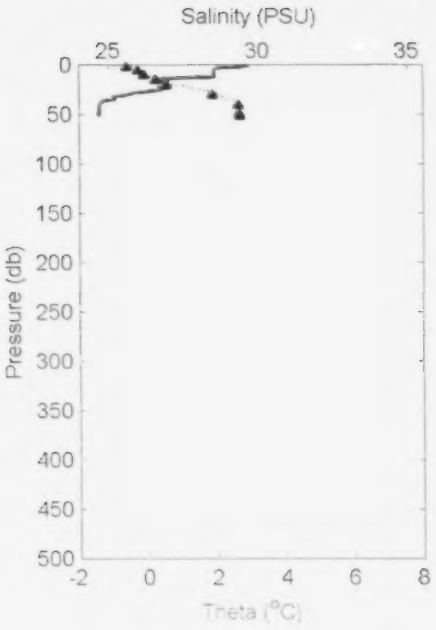


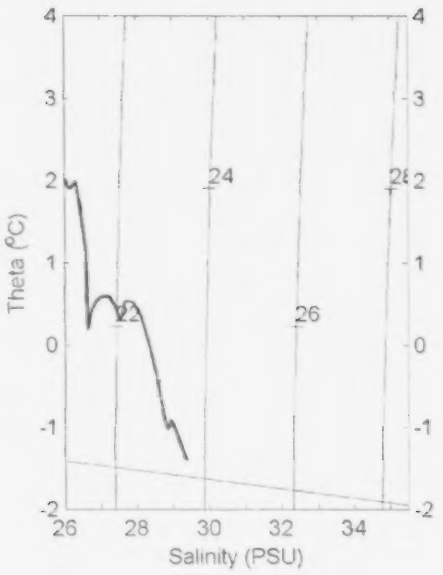


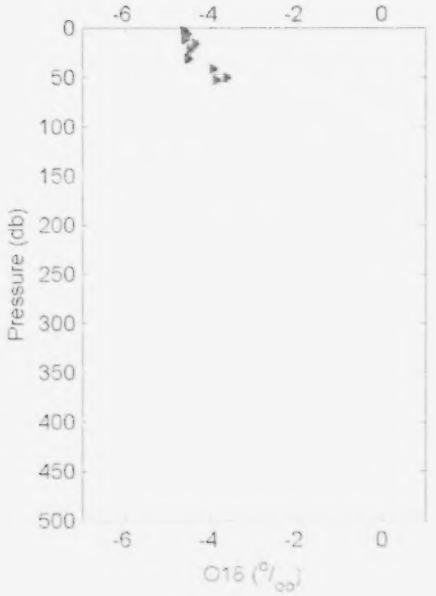


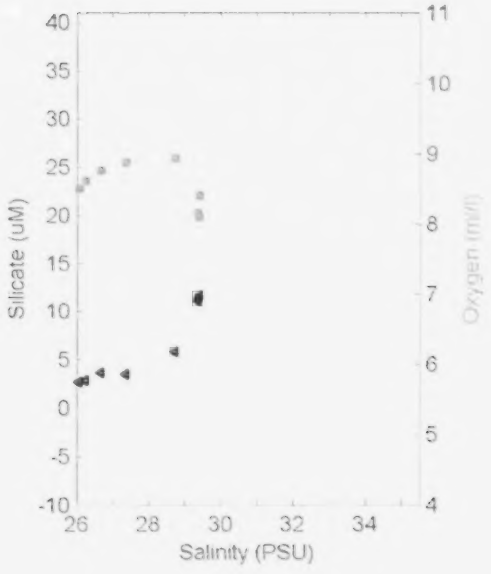


1999-24: Cast 52 Station CC3

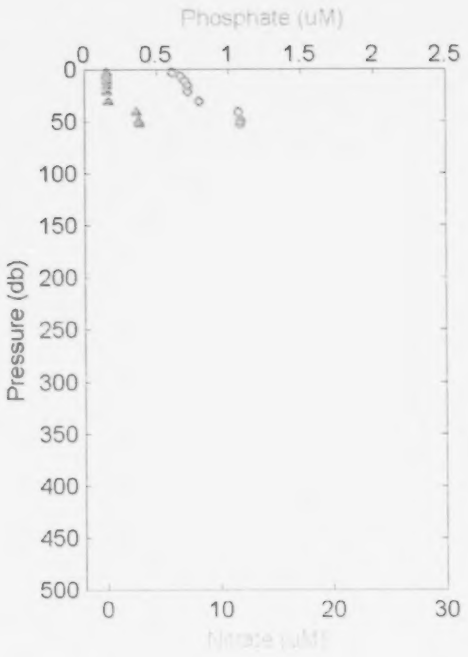


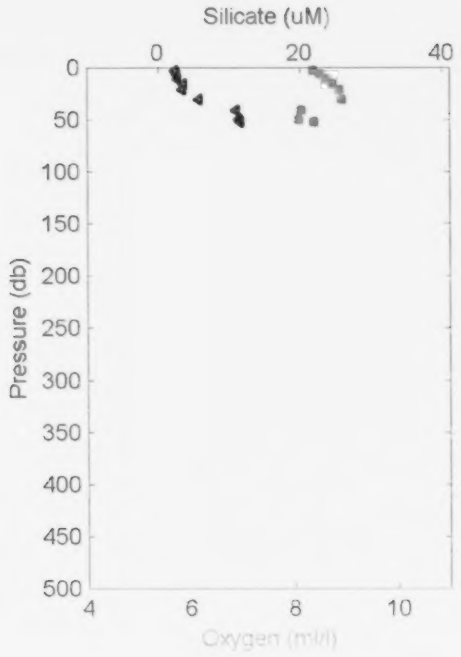


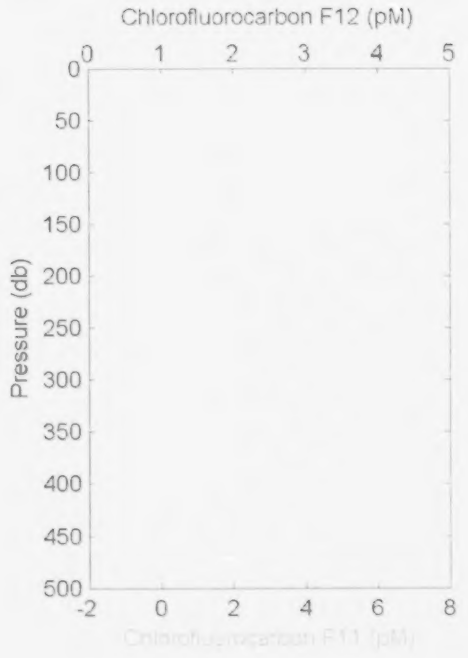


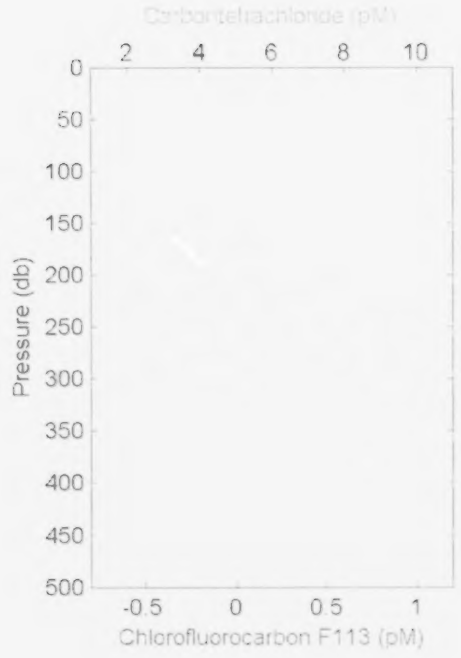


1999-24: Cast 52 Station CC3

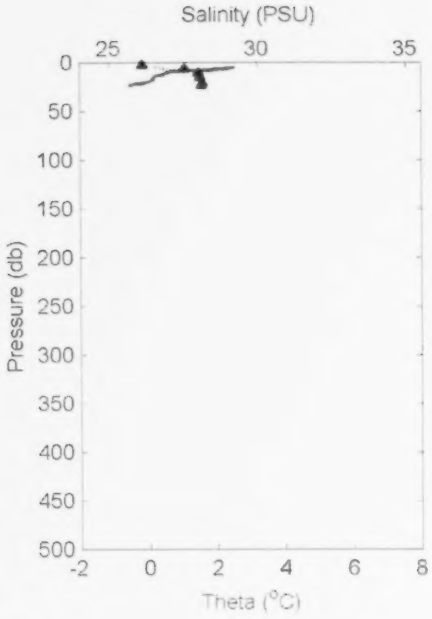


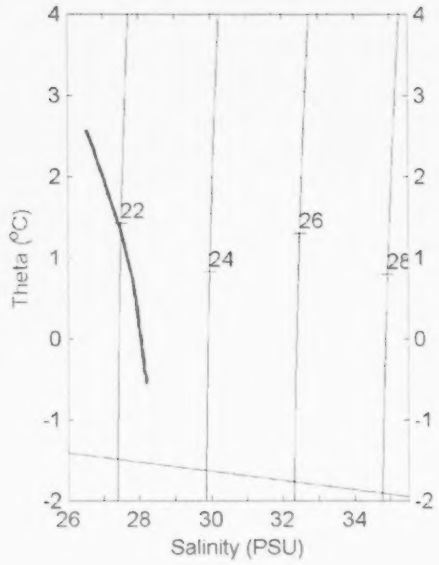


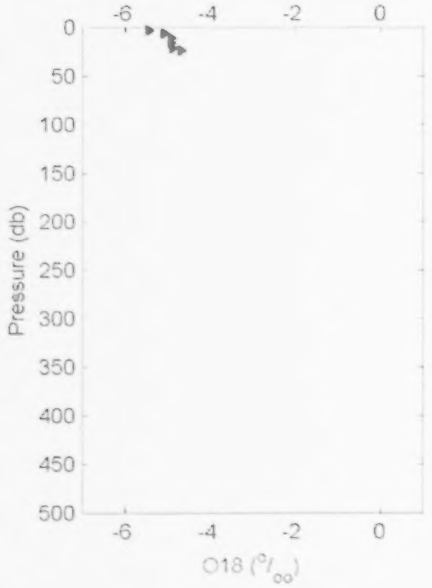


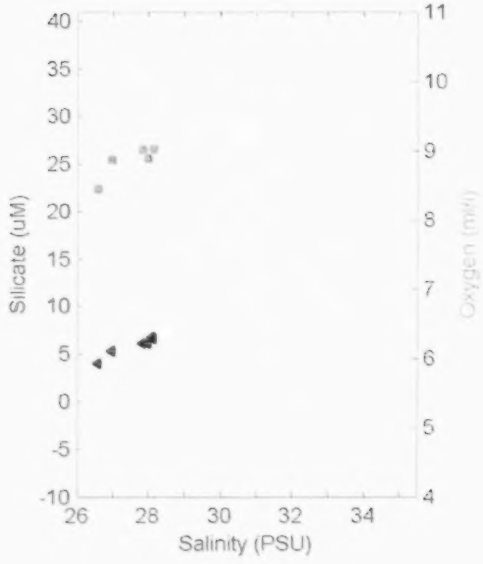


1999-24: Cast 53 Station TP1

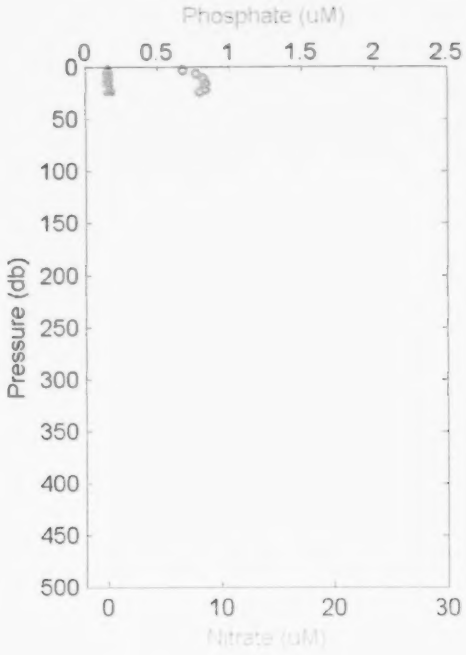


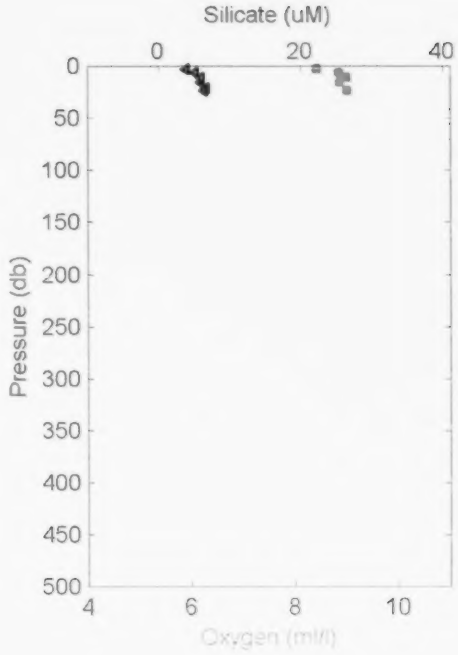


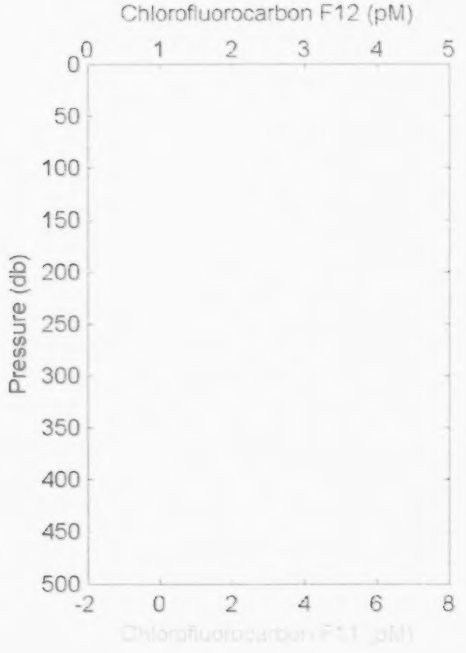


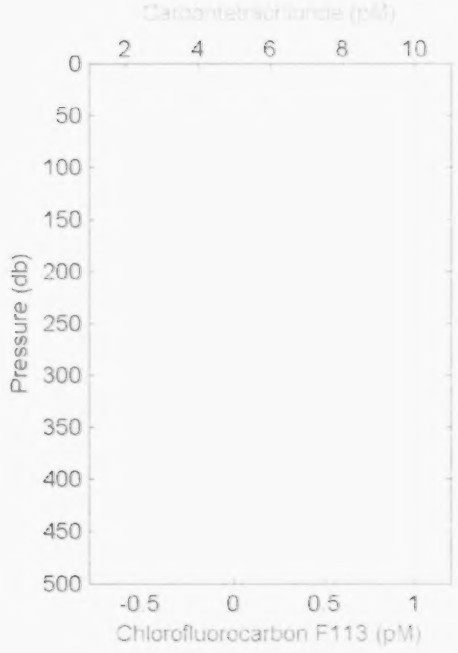


1999-24: Cast 53 Station TP1

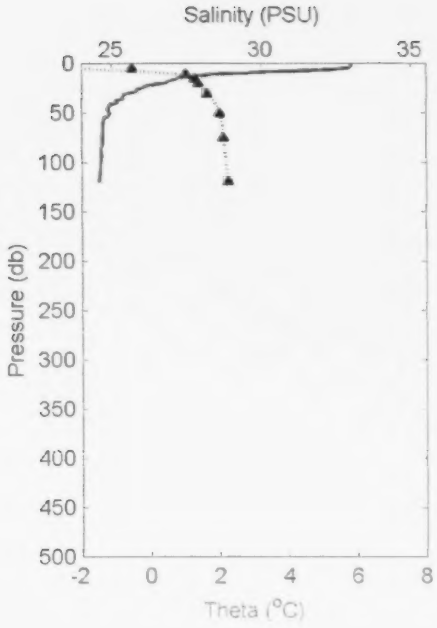


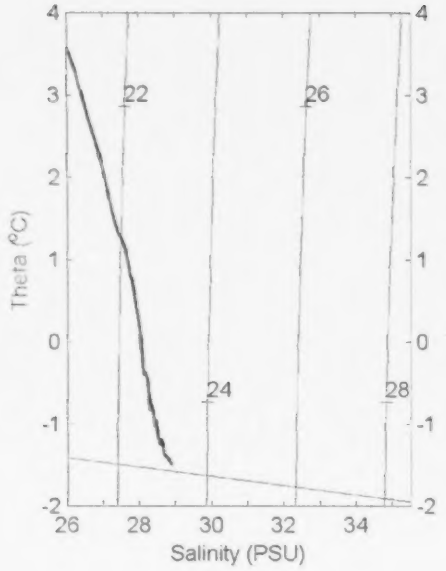


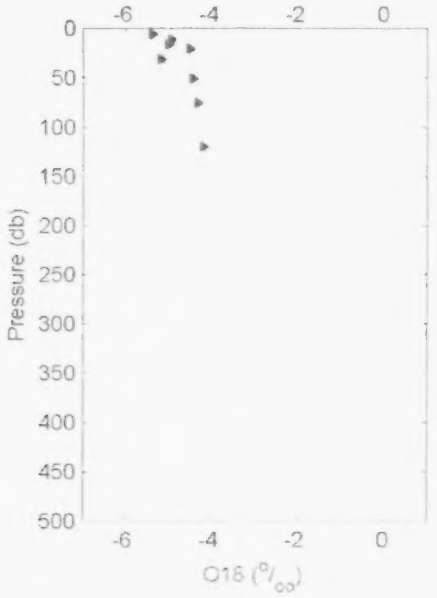


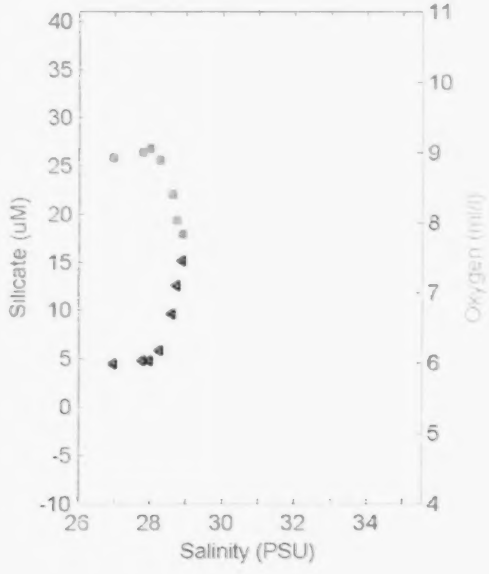


1999-24: Cast 55 Station TP3

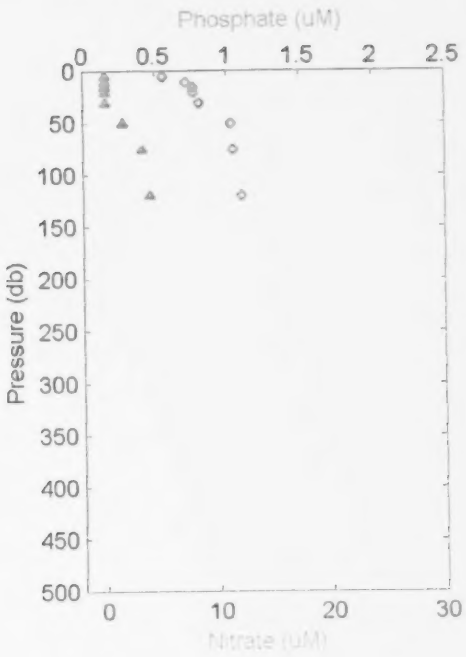


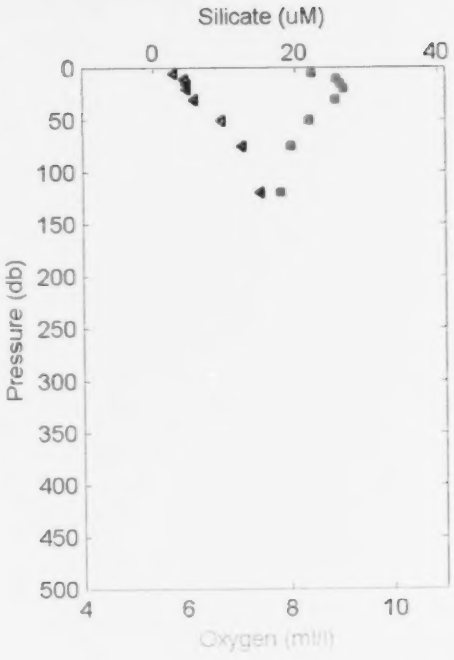


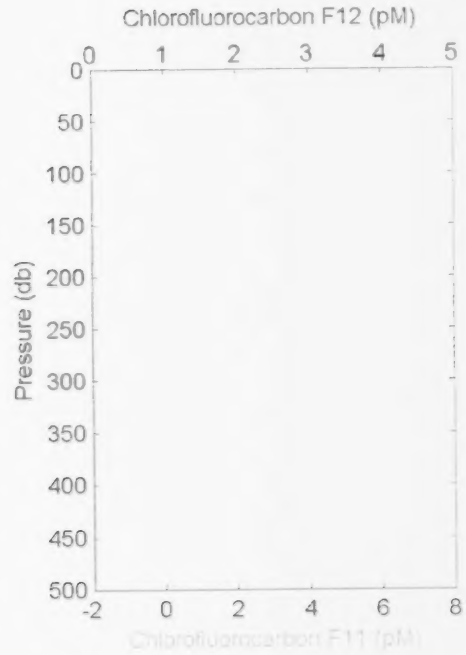


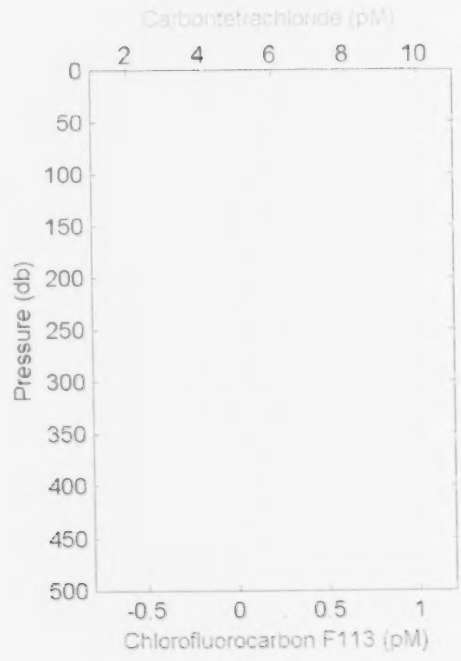


1999-24: Cast 55 Station TP3

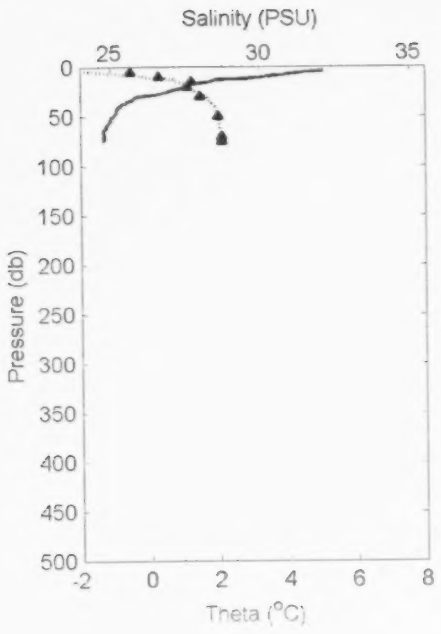


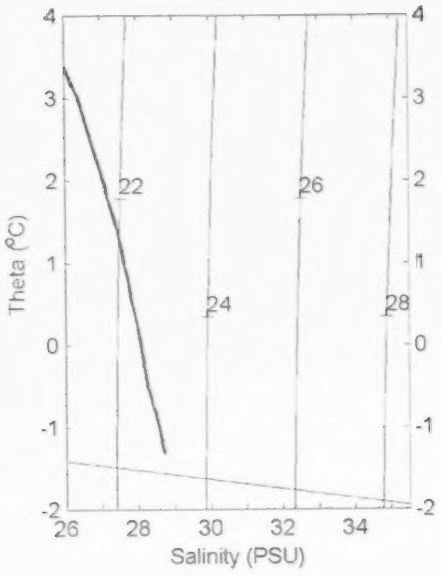


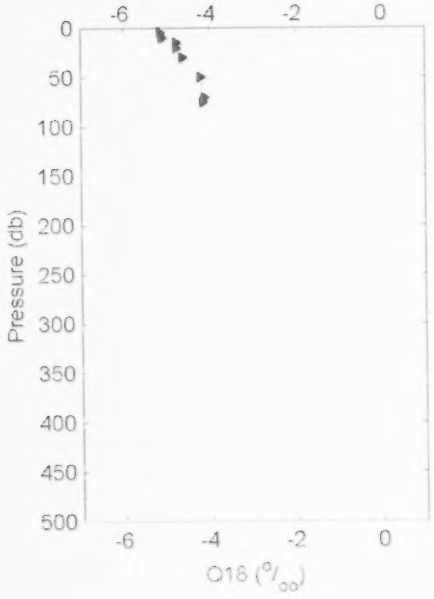


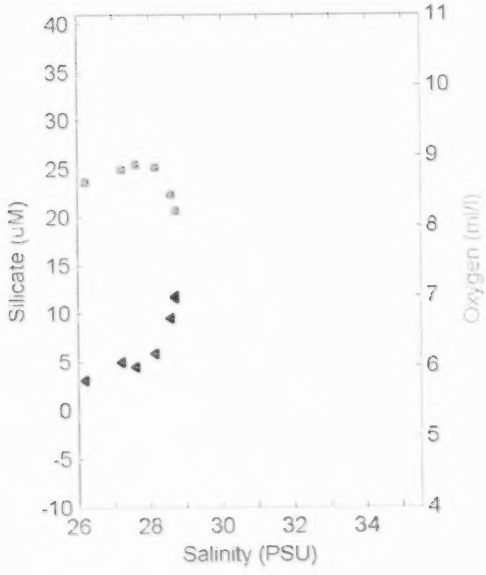


1999-24: Cast 57 Station TP5

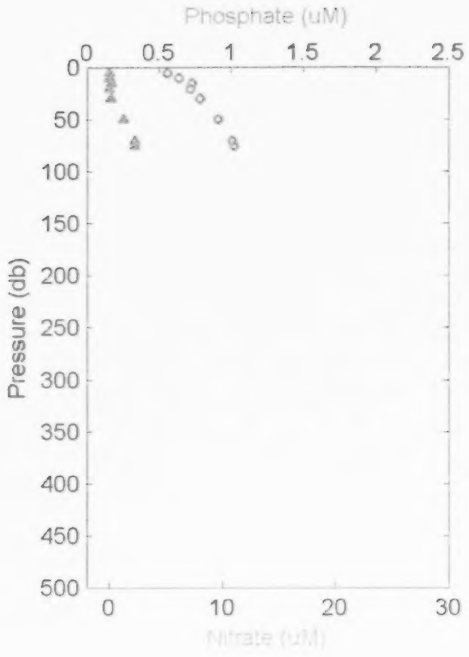


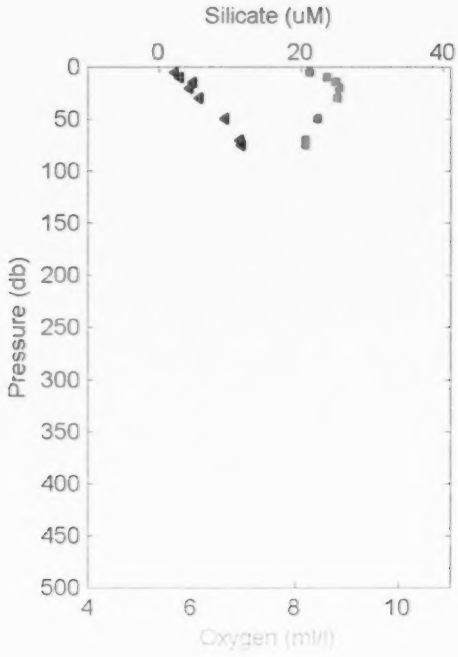


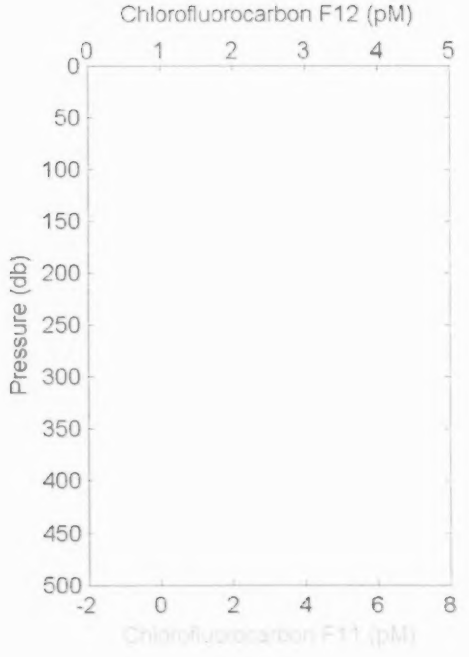


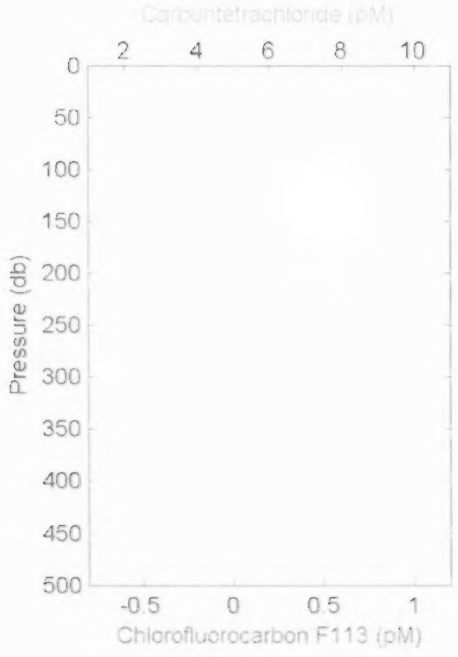


1999-24: Cast 57 Station TP5

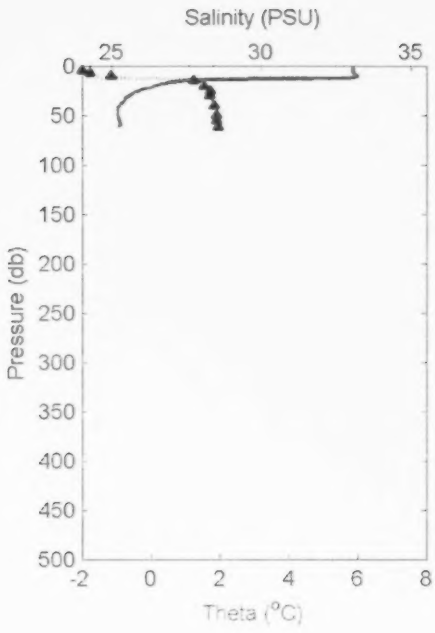


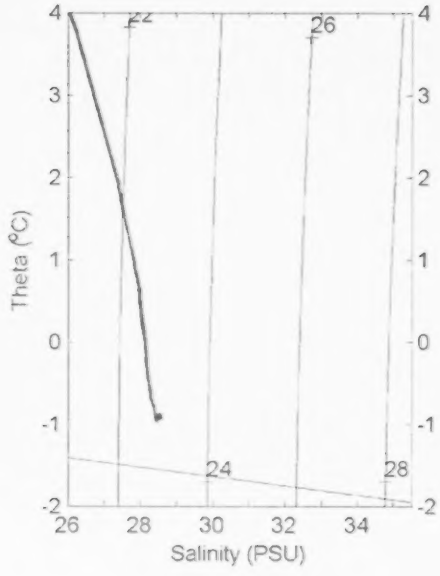


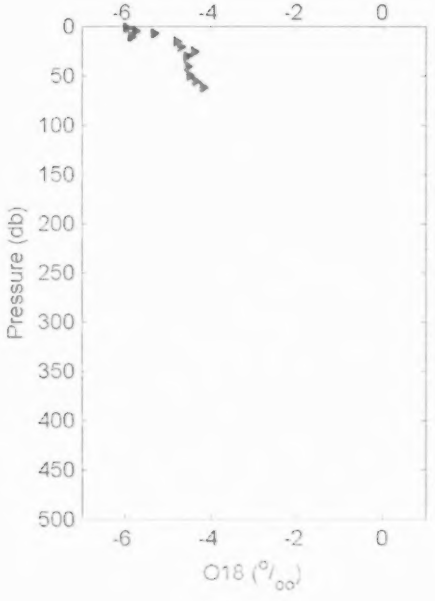


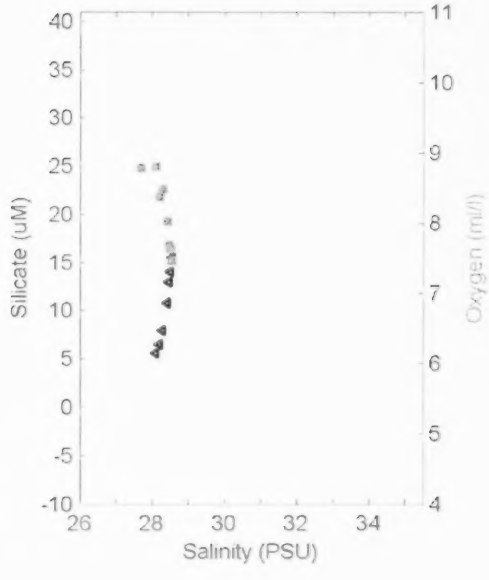


1999-24: Cast 58 Station EI1

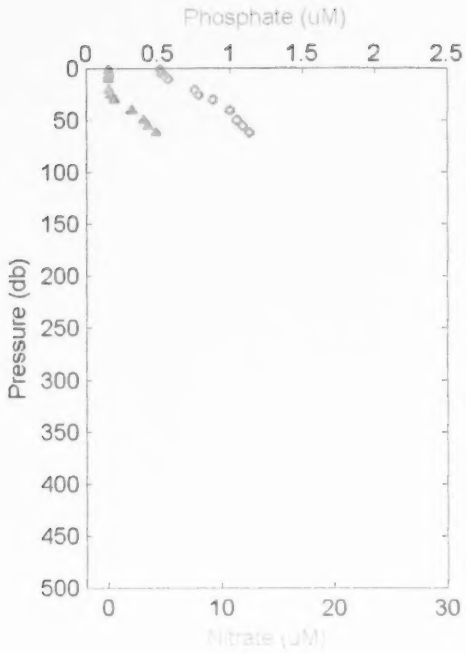


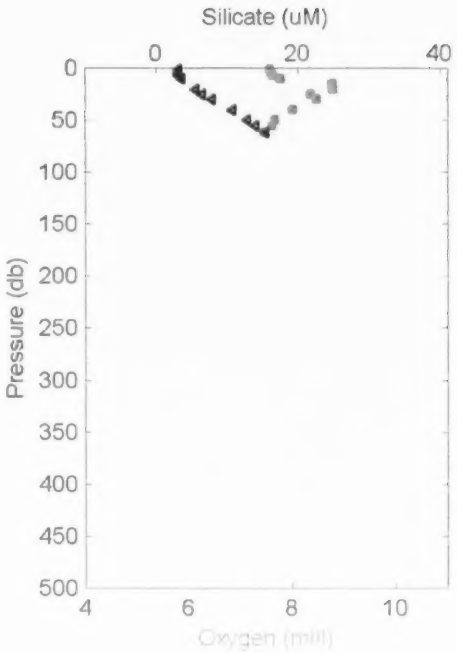


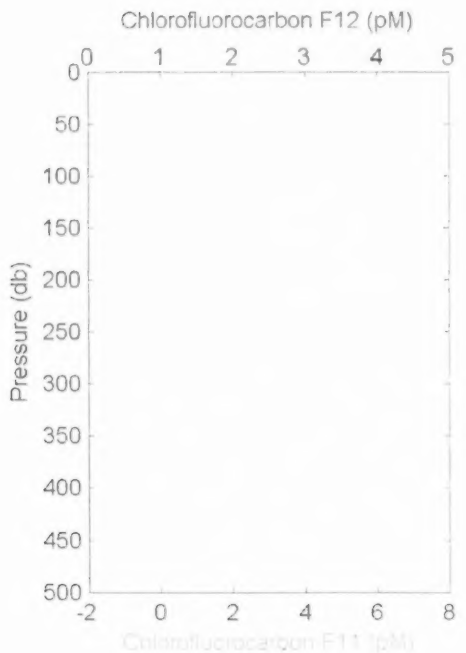


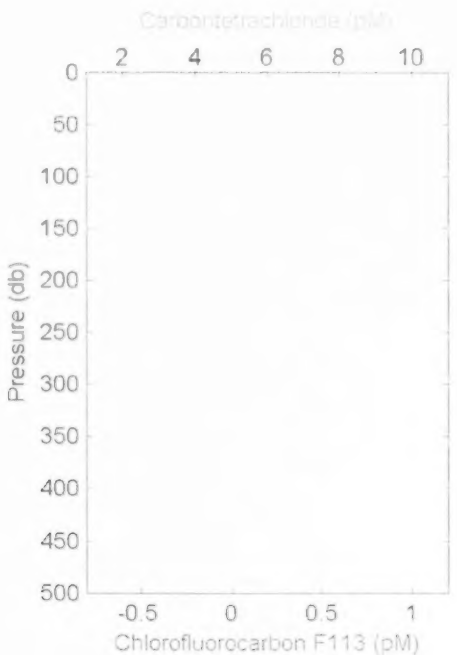


1999-24: Cast 58 Station EI1

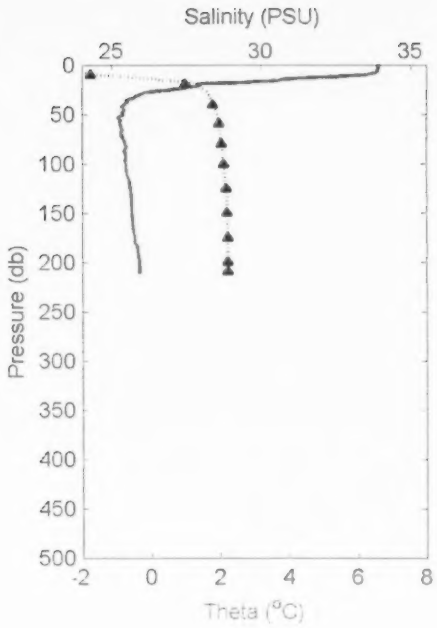


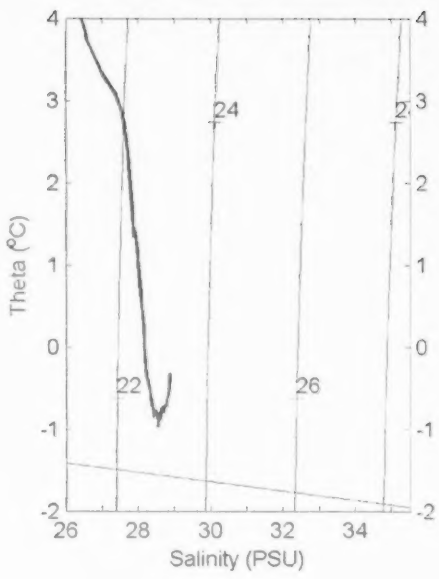


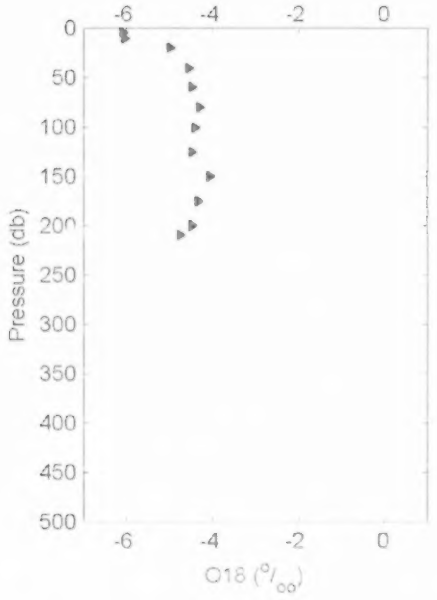


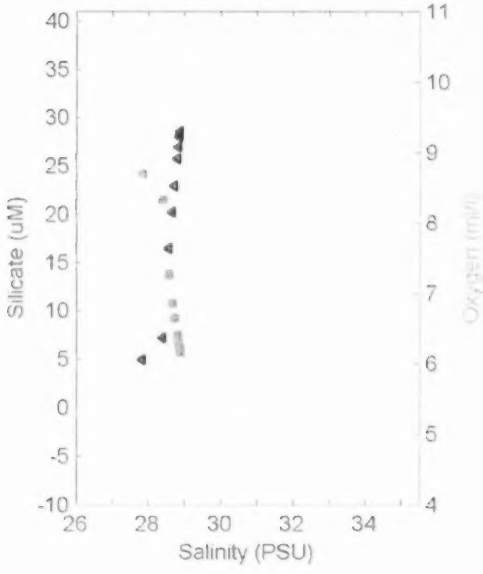


1999-24: Cast 62 Station EI5

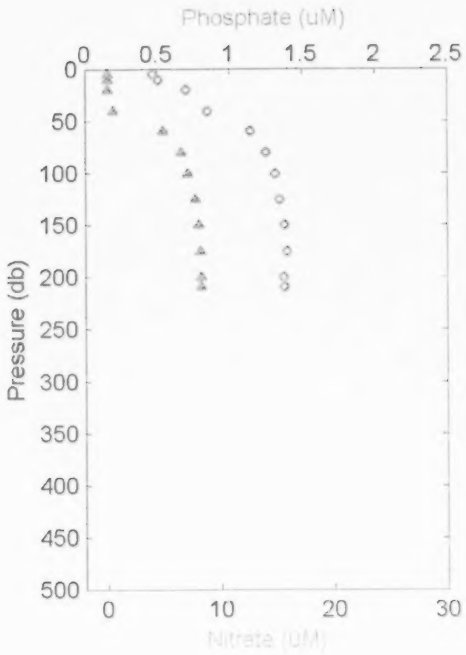


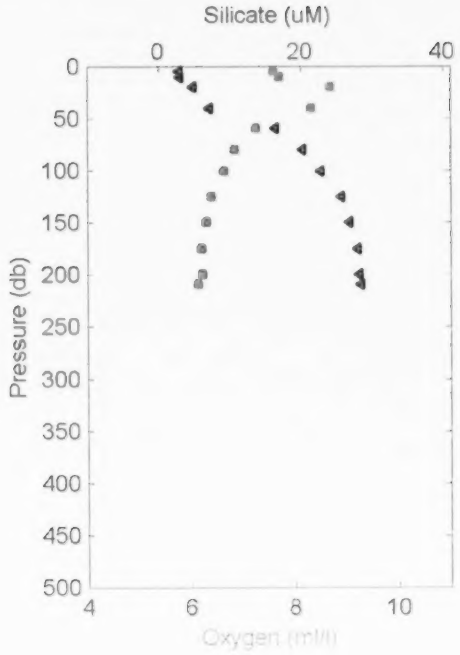


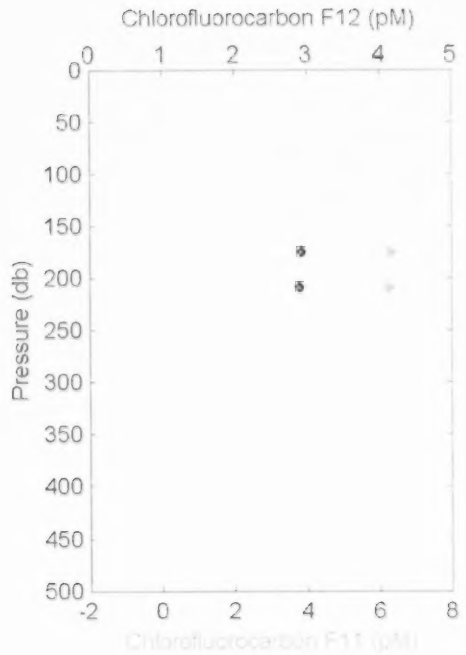


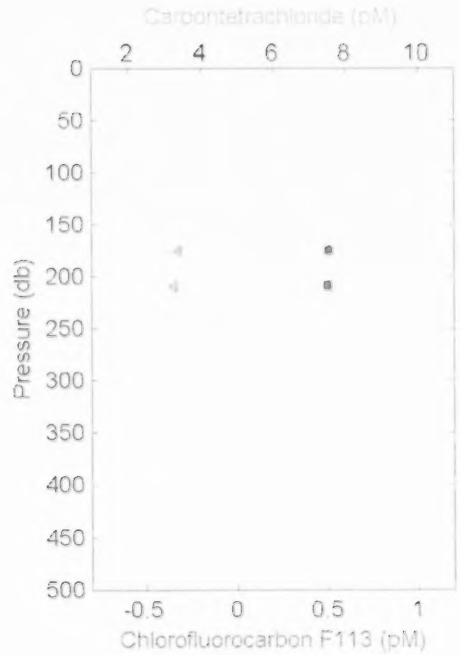


1999-24: Cast 62 Station EI5

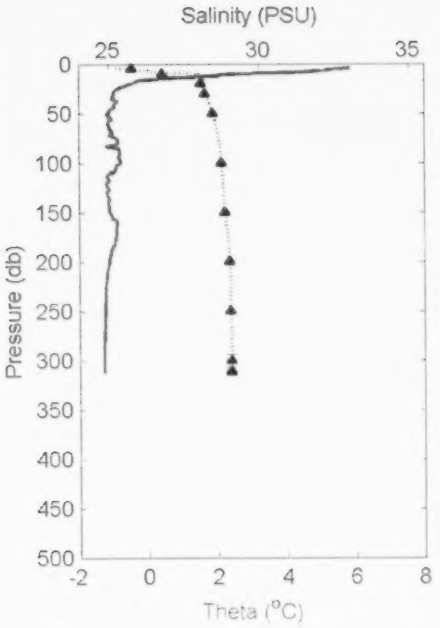


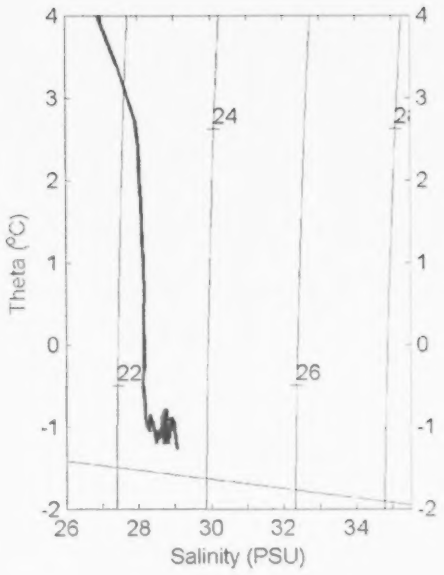


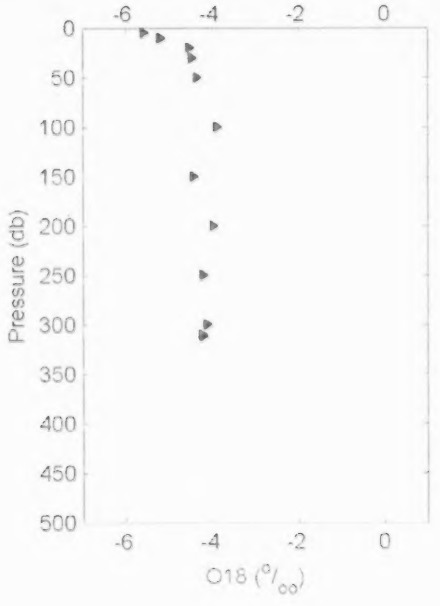


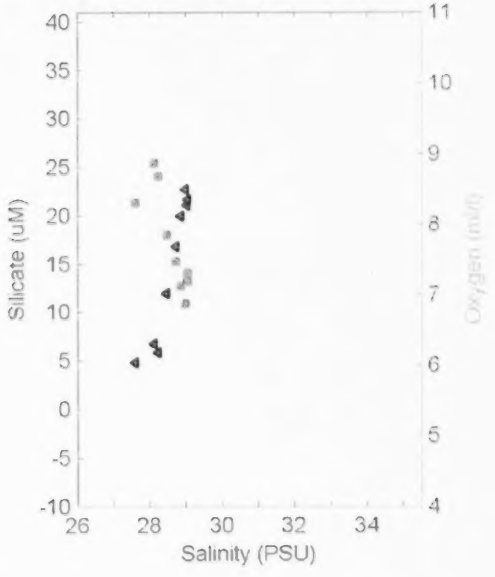


1999-24: Cast 67 Station EI7

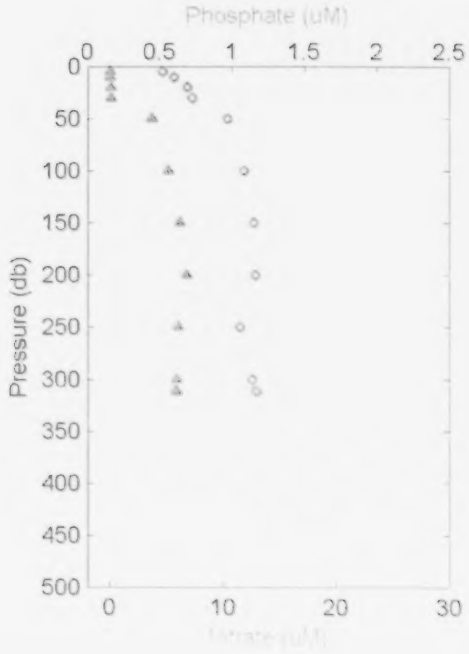


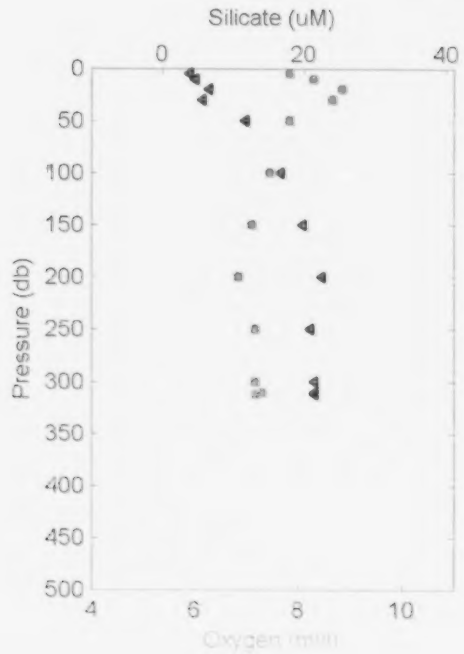


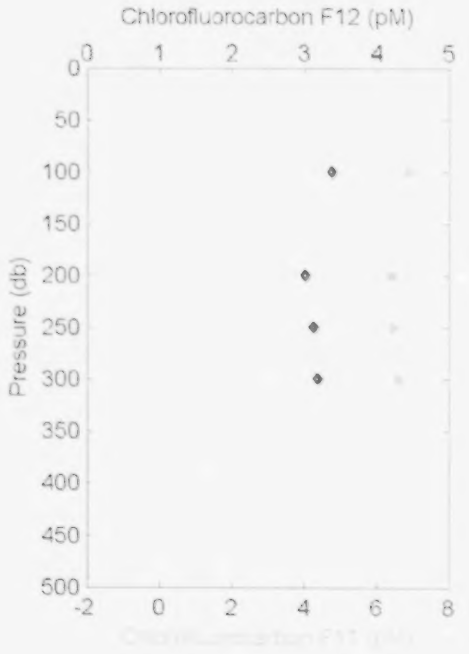


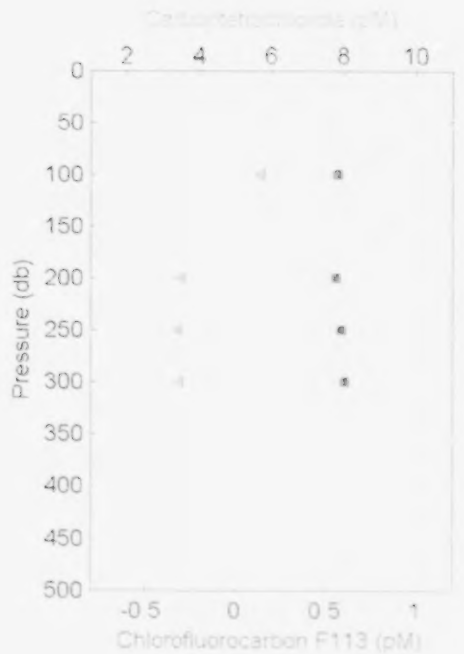


1999-24: Cast 67 Station EI7

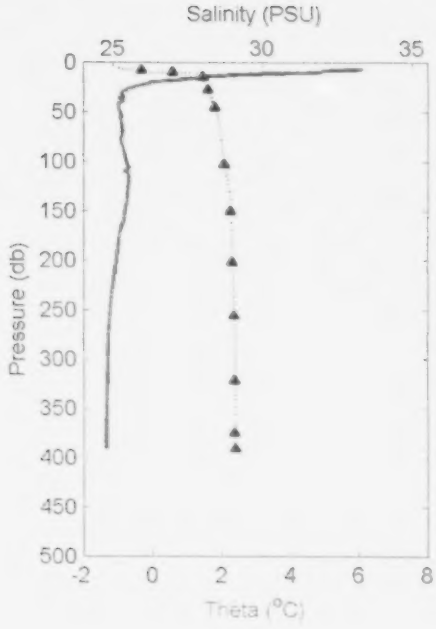


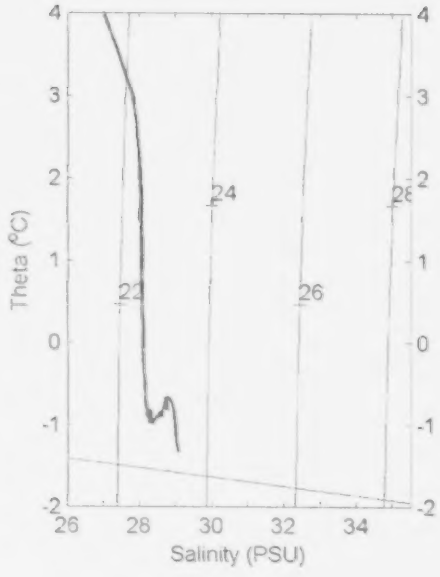


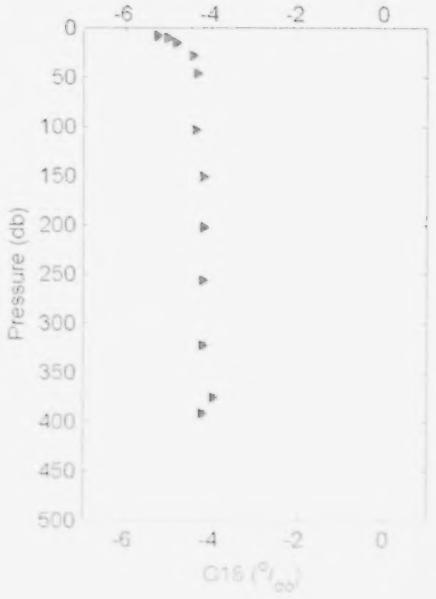


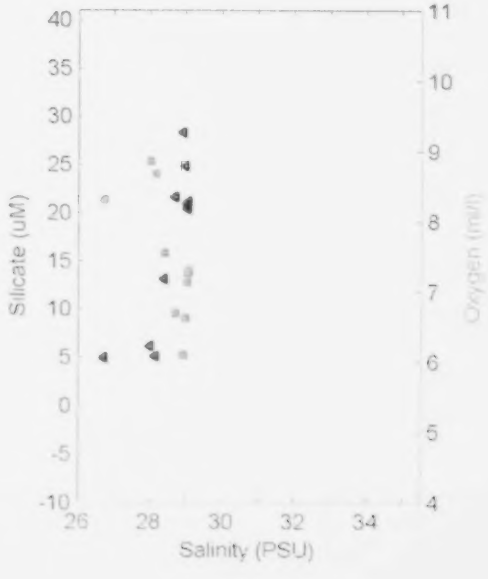


1999-24: Cast 69 Station EI9

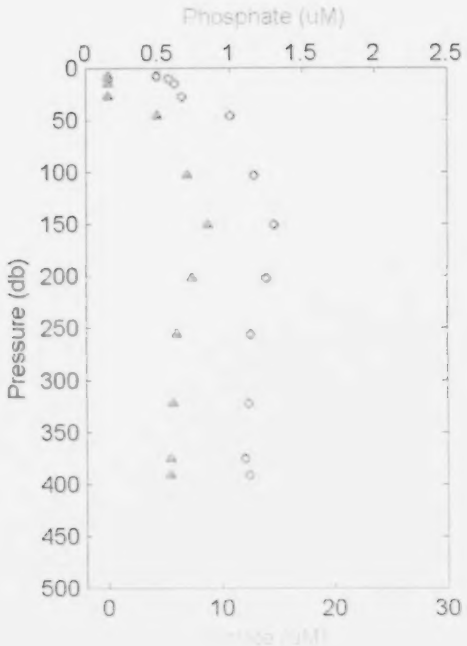


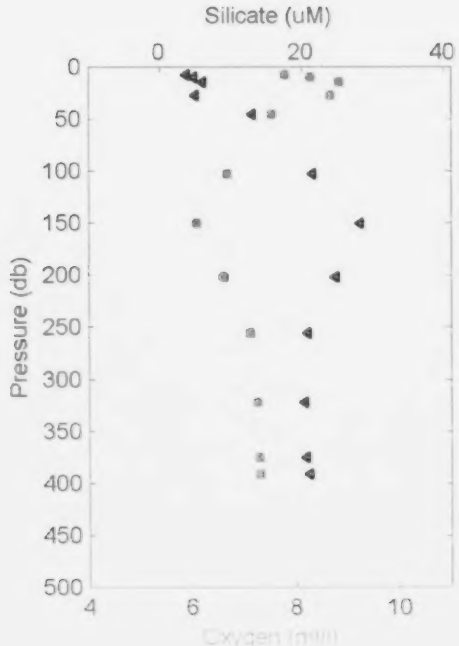


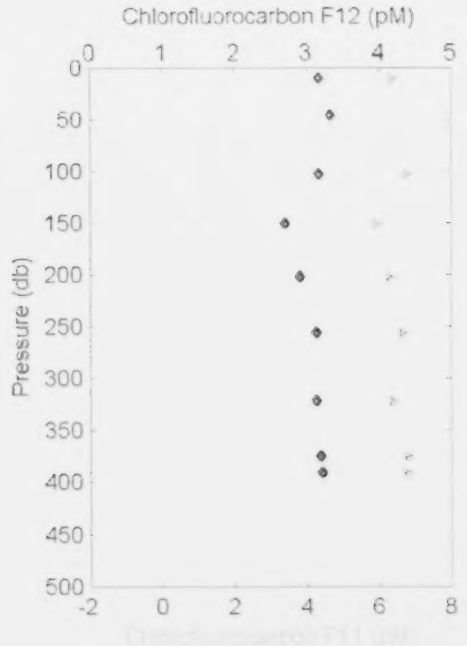




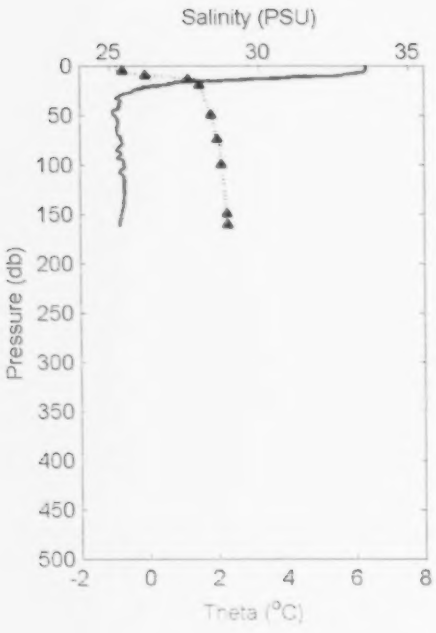
1999-24: Cast 69 Station EI9

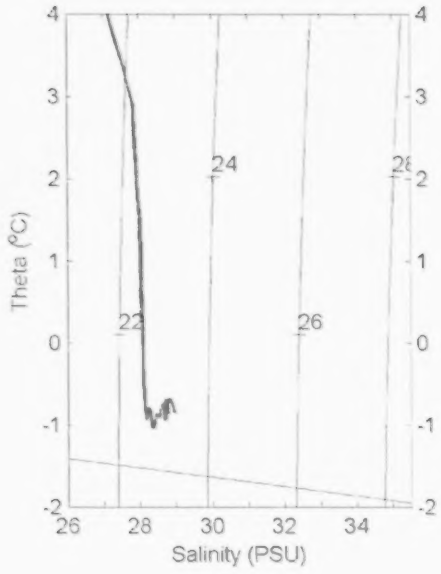


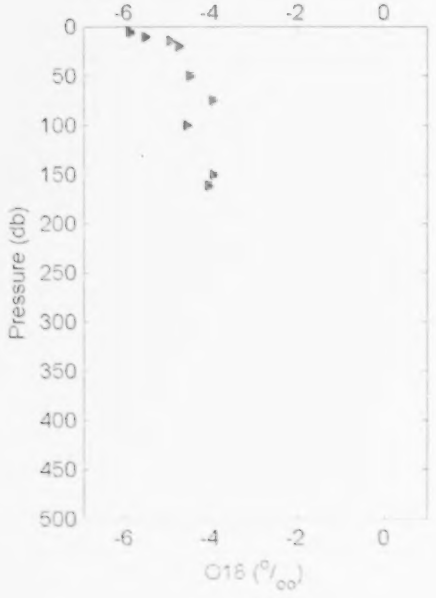


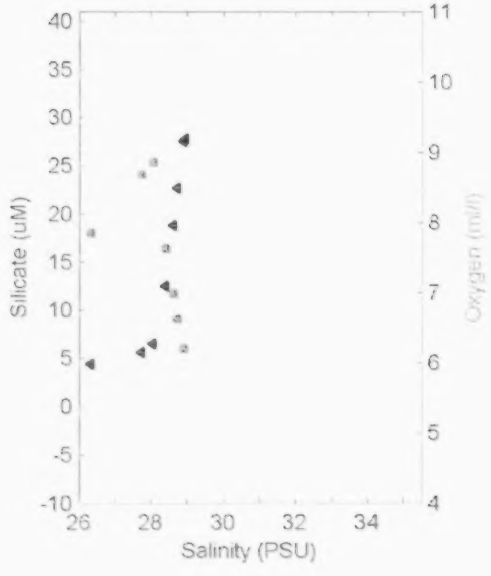


1999-24: Cast 70 Station EI10

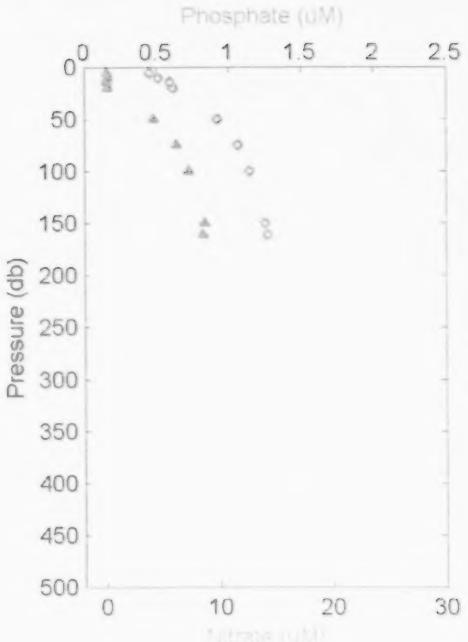


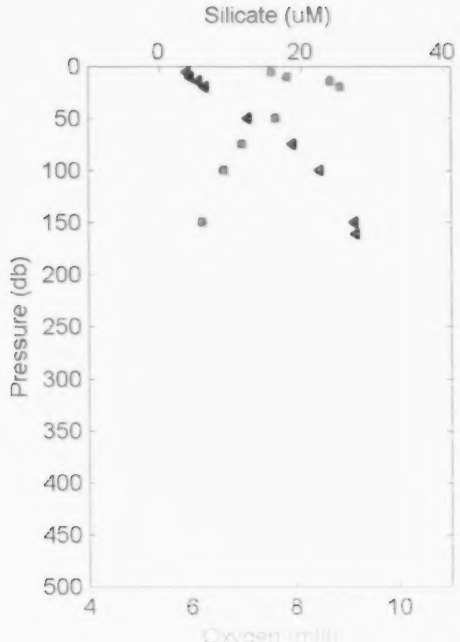


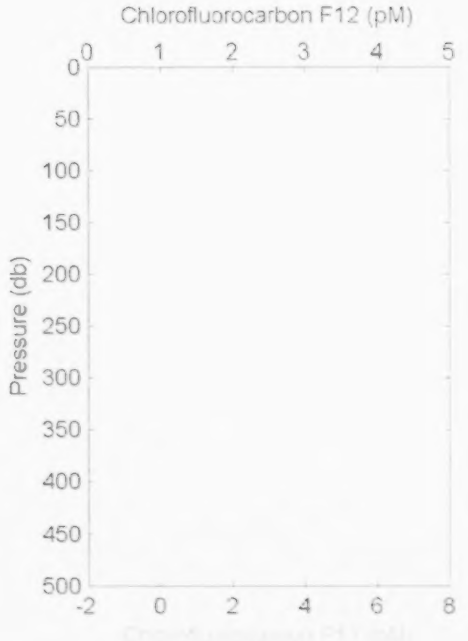


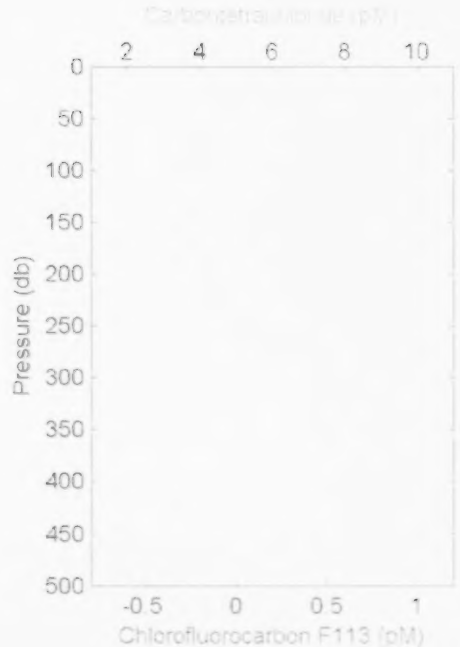


1999-24: Cast 70 Station EI10

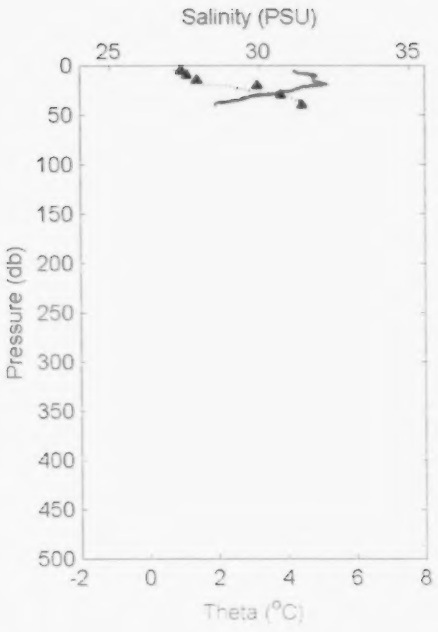


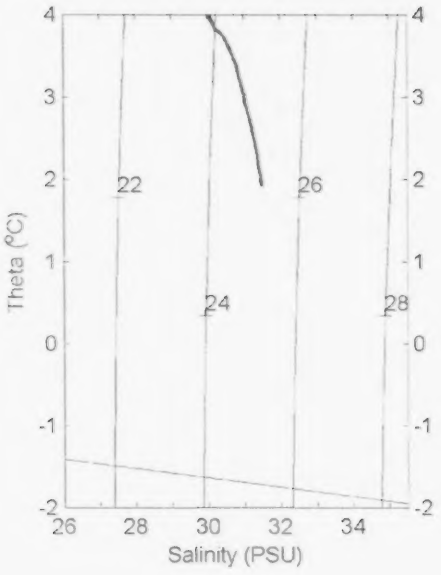


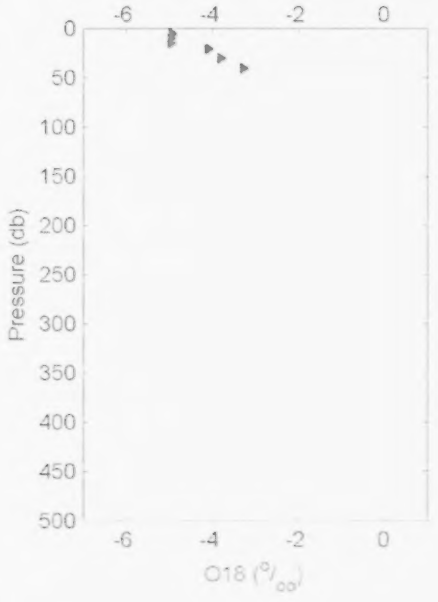


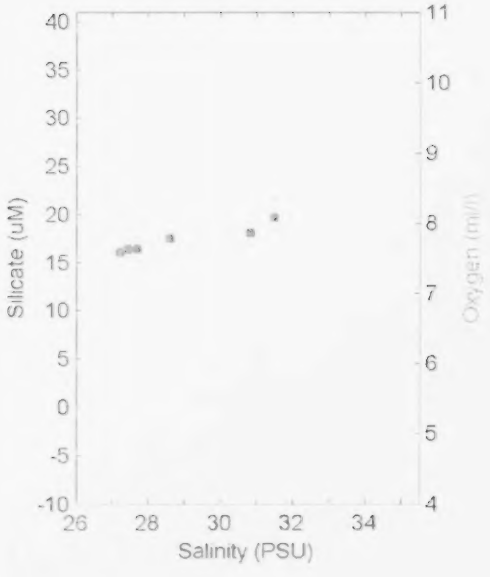


1999-24: Cast 78 Station CI3

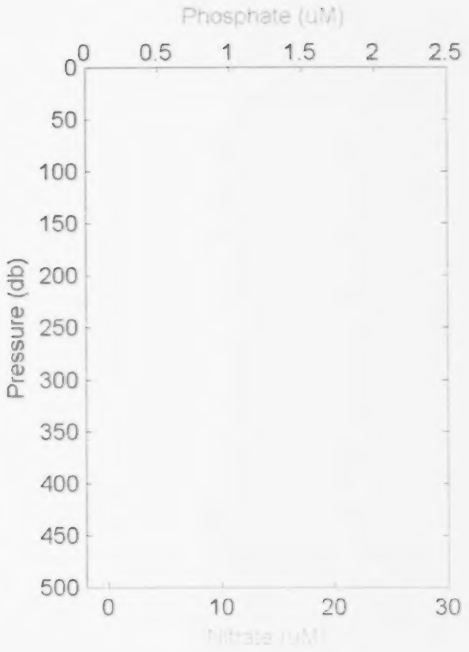


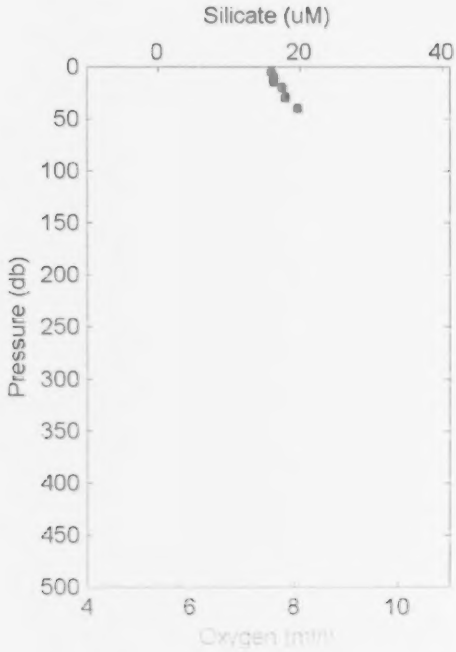


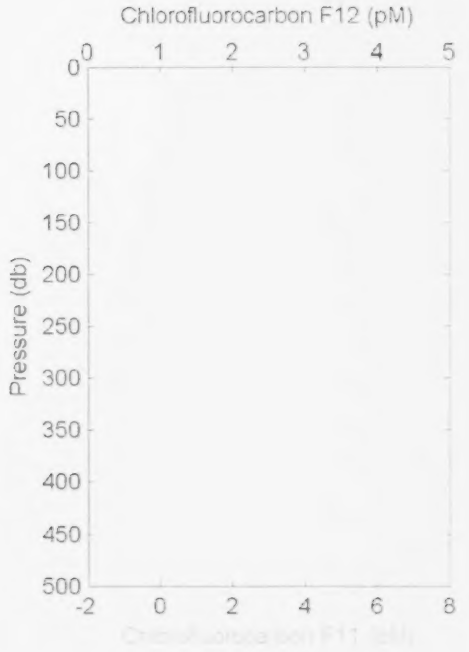


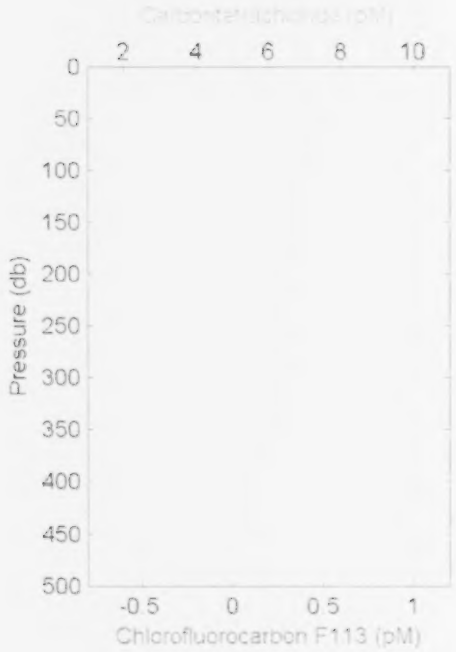


1999-24: Cast 78 Station CI3

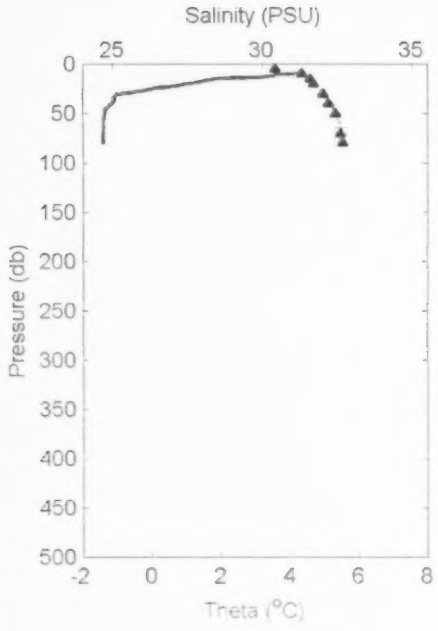


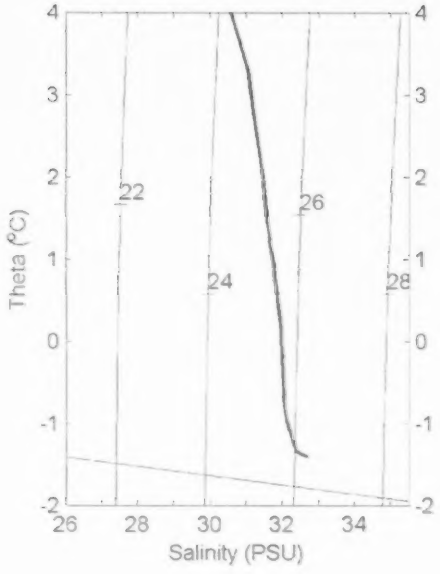


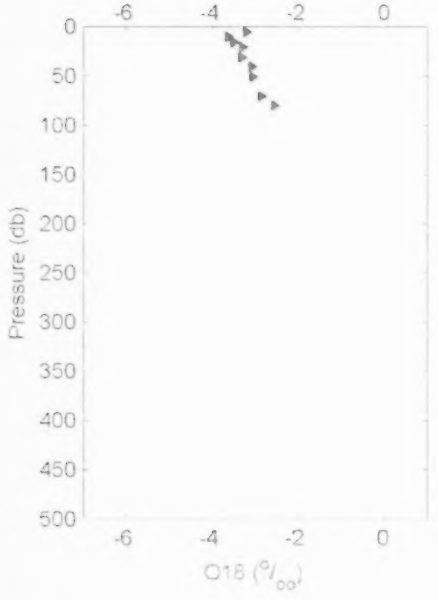


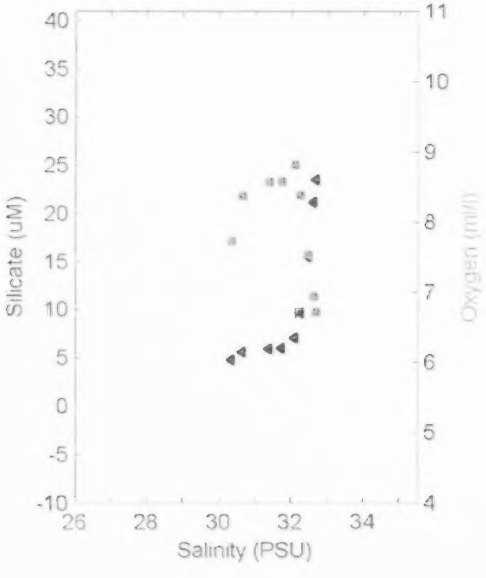


1999-24: Cast 83 Station AG1

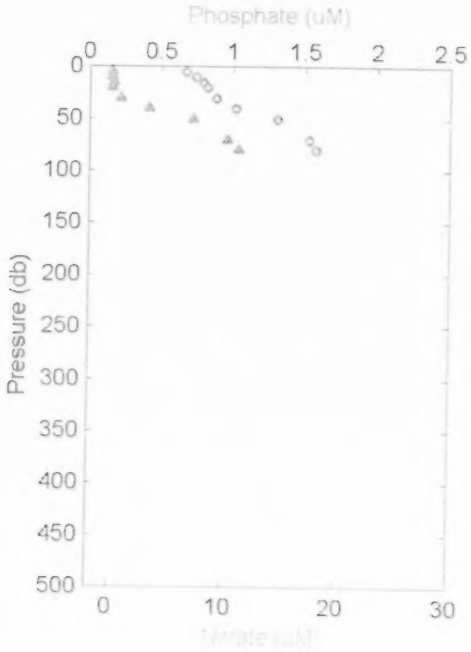


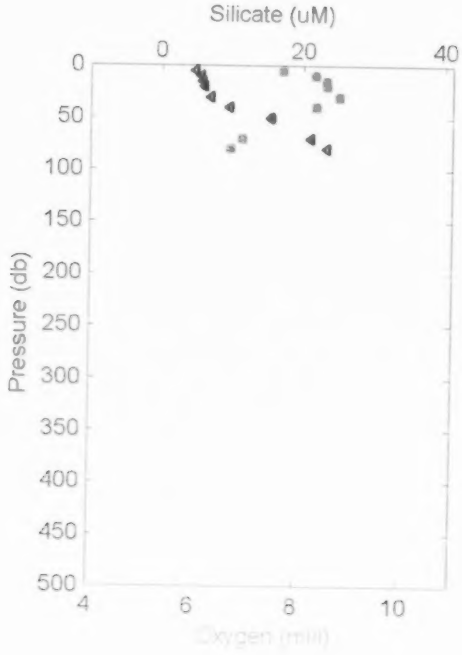


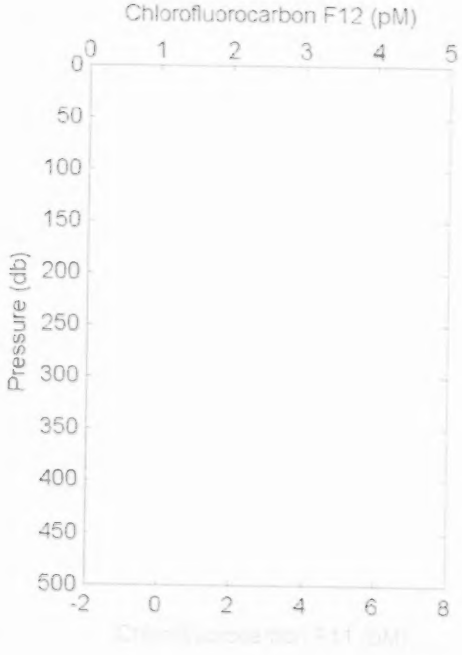


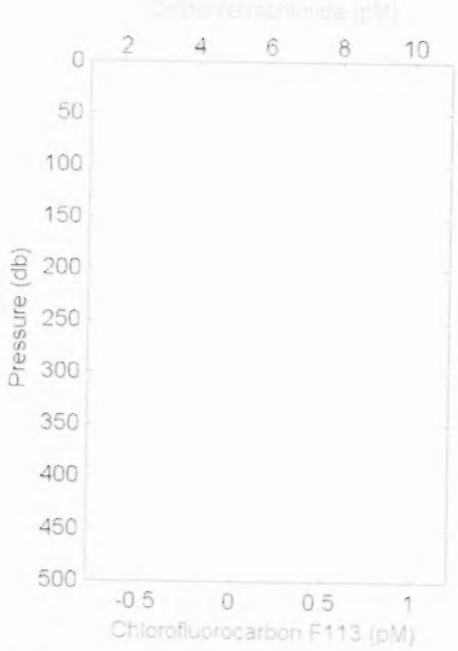


1999-24: Cast 83 Station AG1

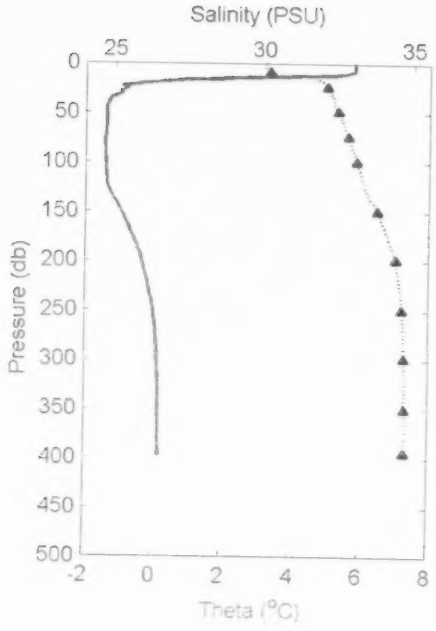


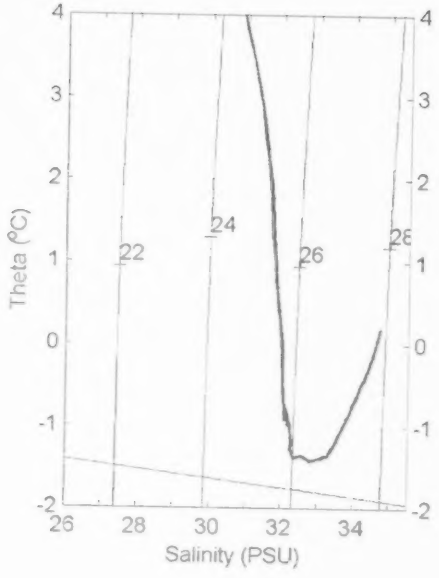


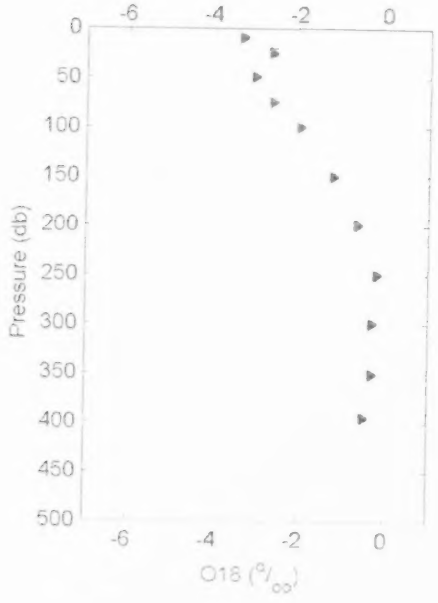


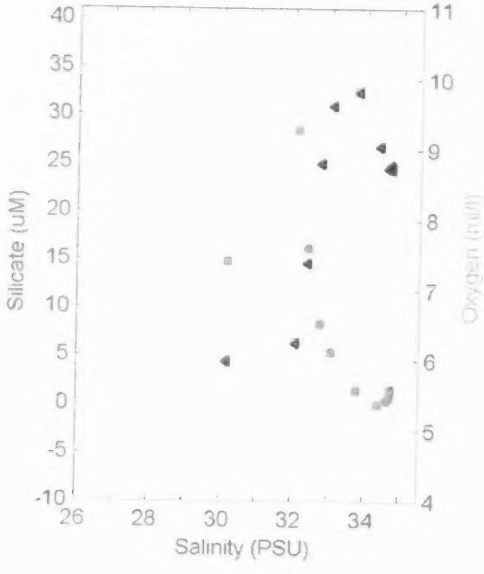


1999-24: Cast 87 Station AG4

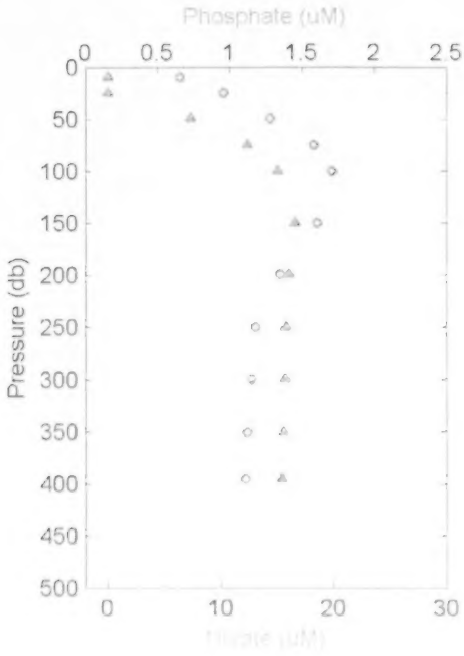


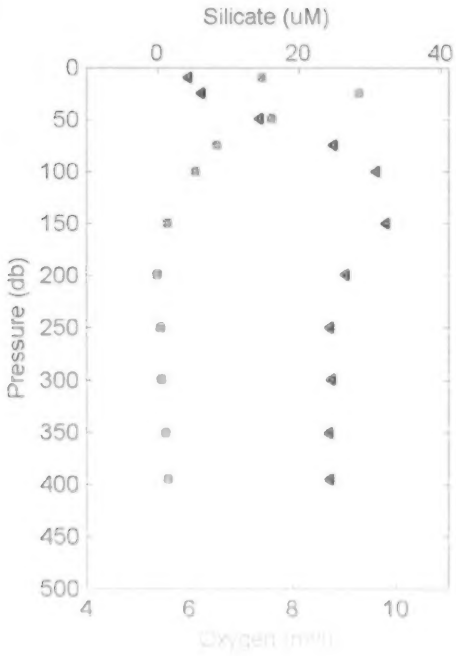


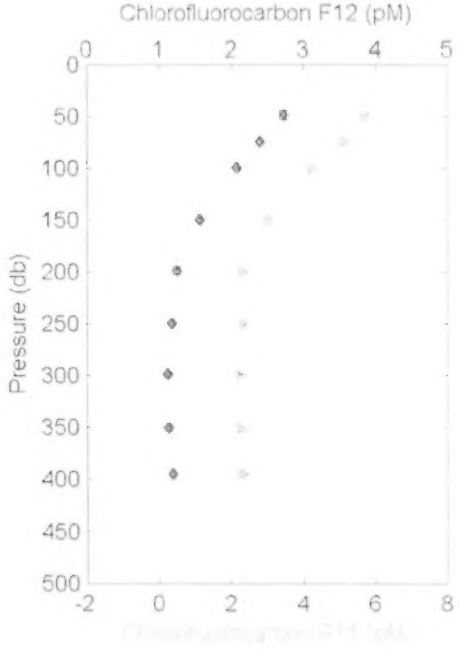


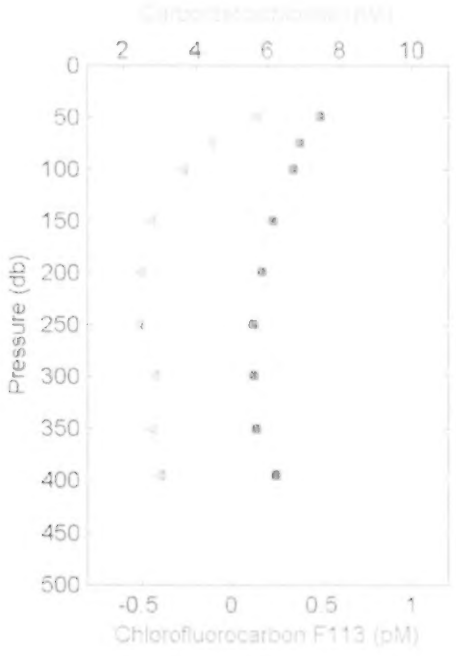


1999-24: Cast 87 Station AG4

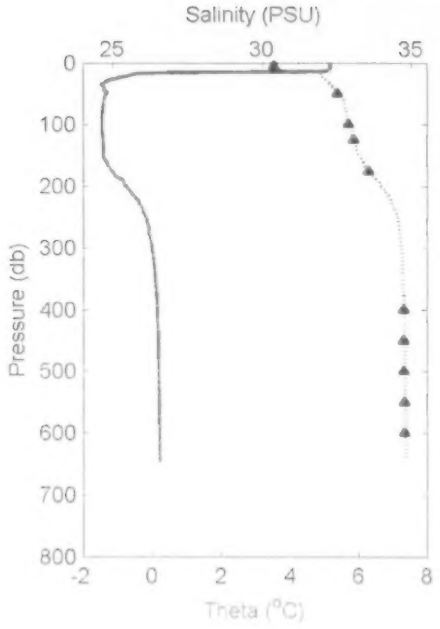


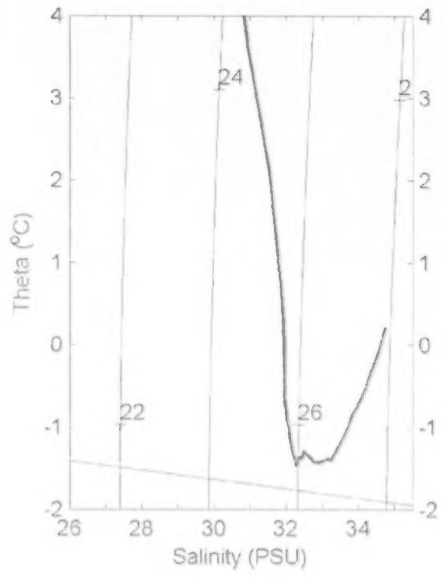


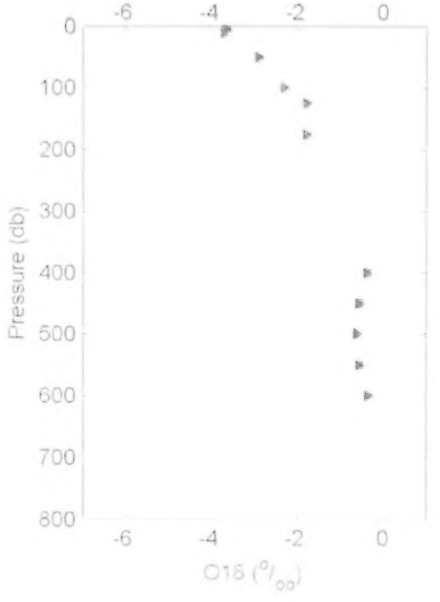


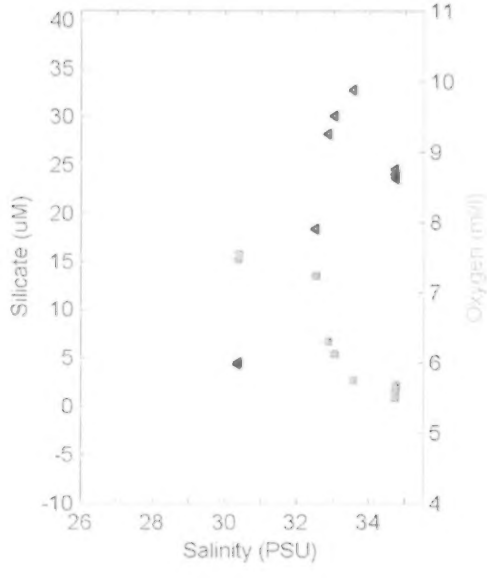


1999-24: Cast 89 Station AG5

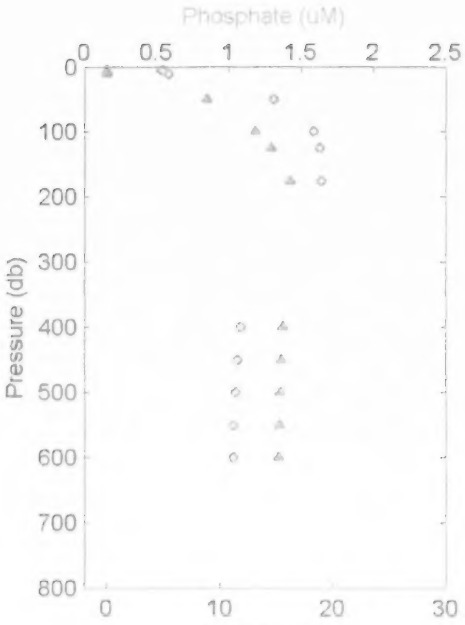


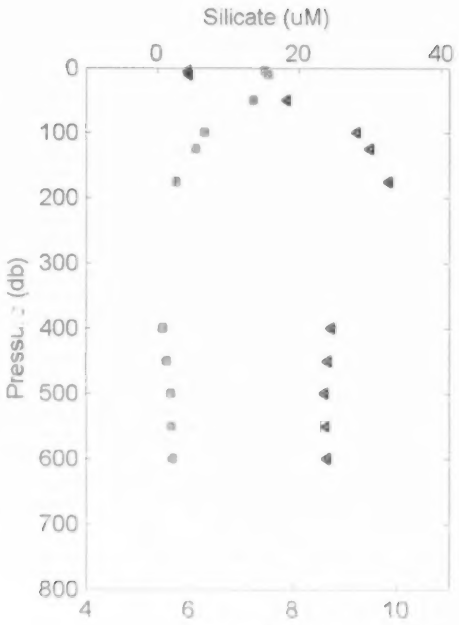


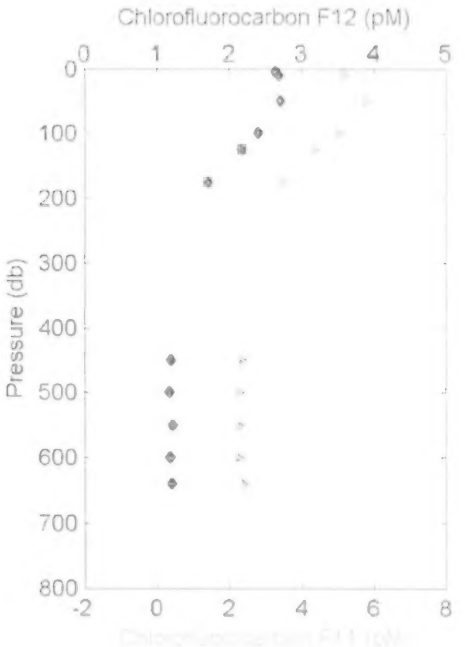


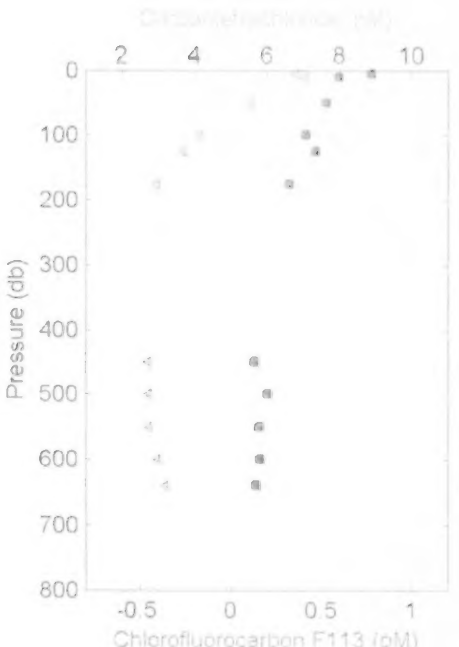


1999-24: Cast 89 Station AG5

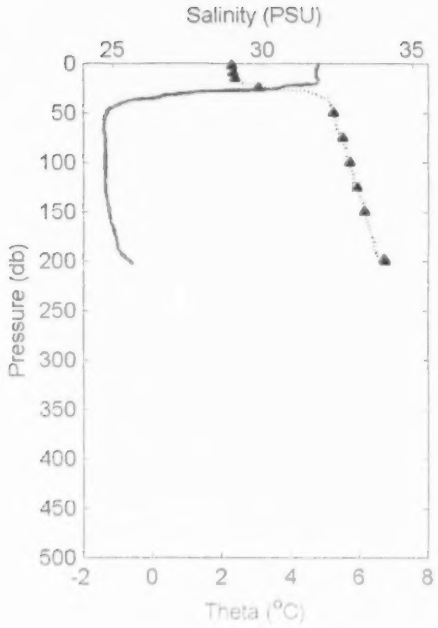


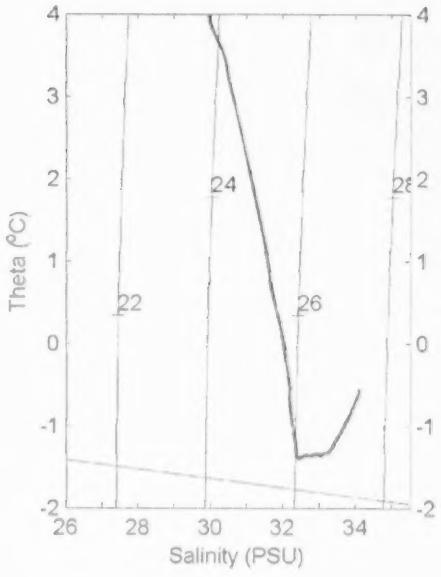


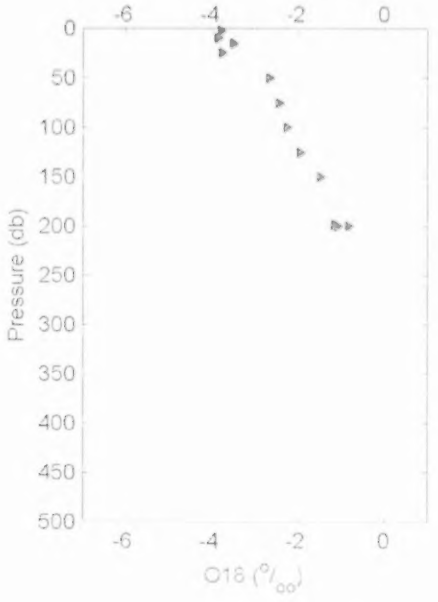


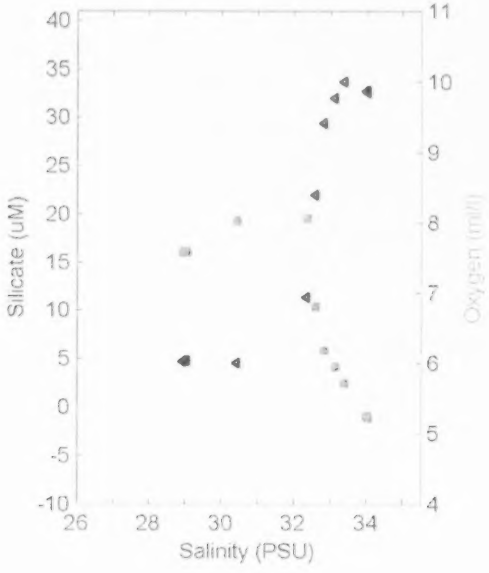


1999-24: Cast 95 Station AG9

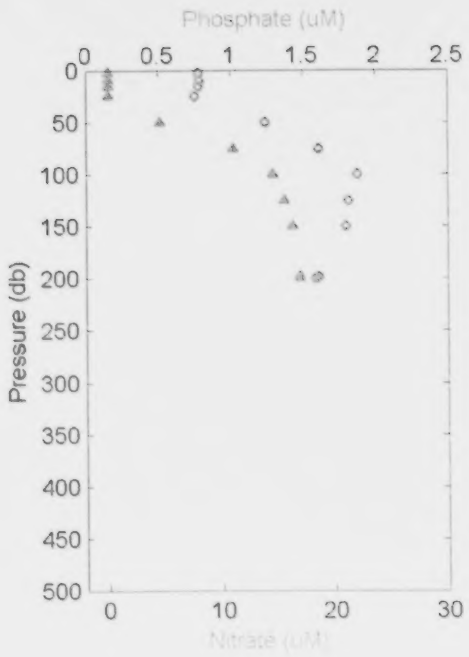


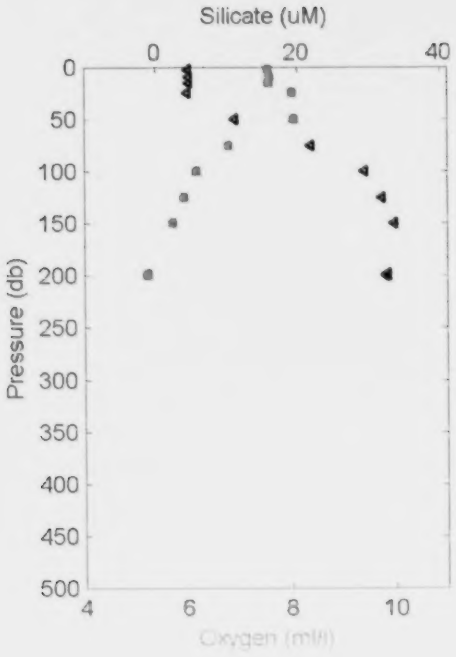


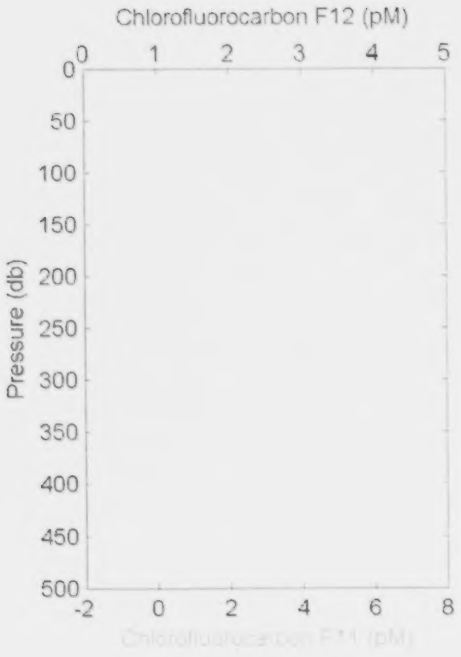


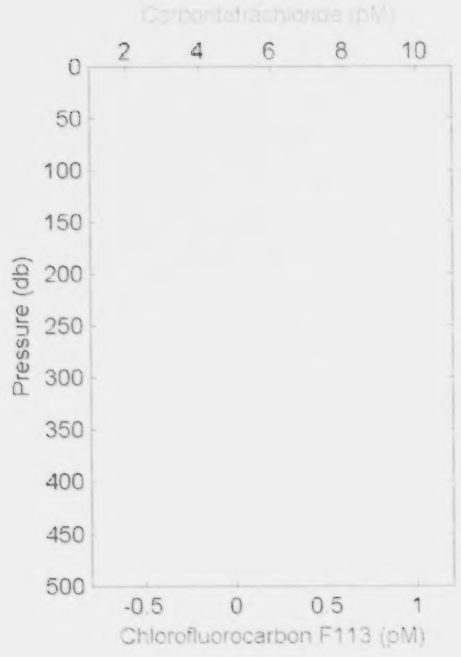


1999-24: Cast 95 Station AG9

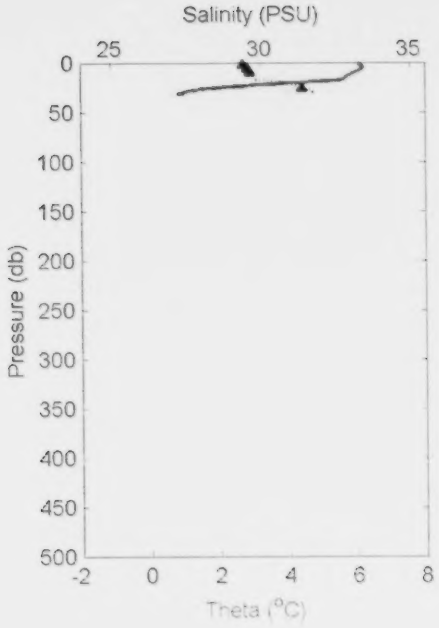


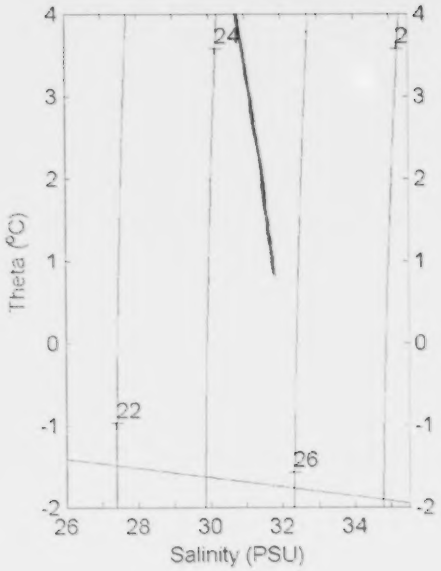


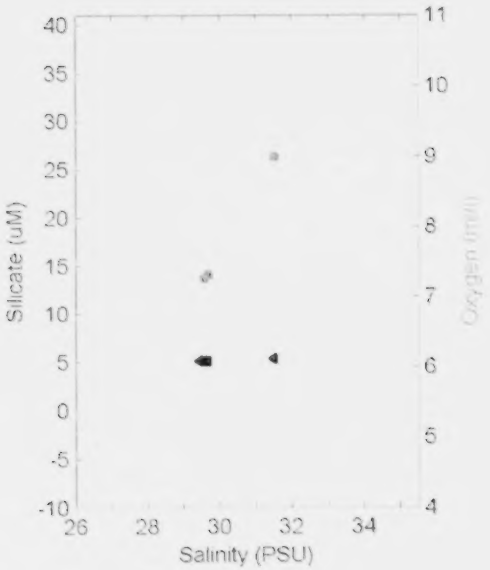




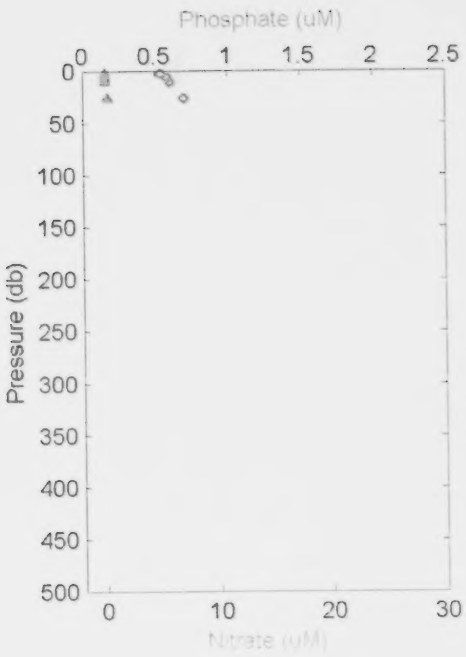
1999-24: Cast 97 Station JB1

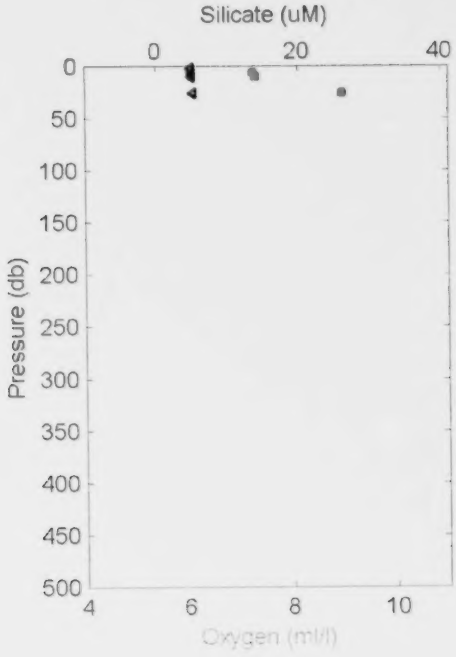


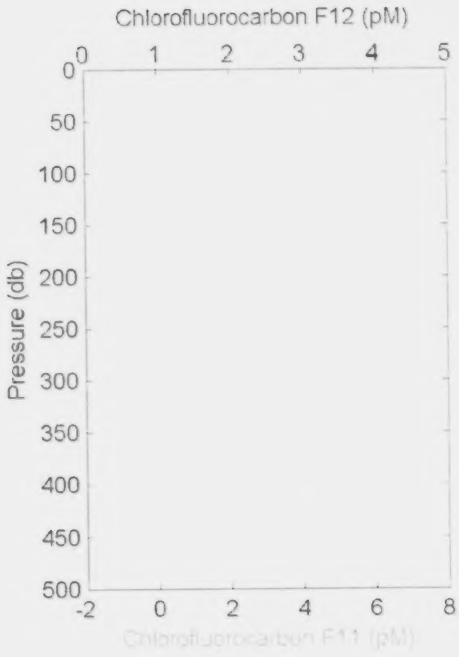


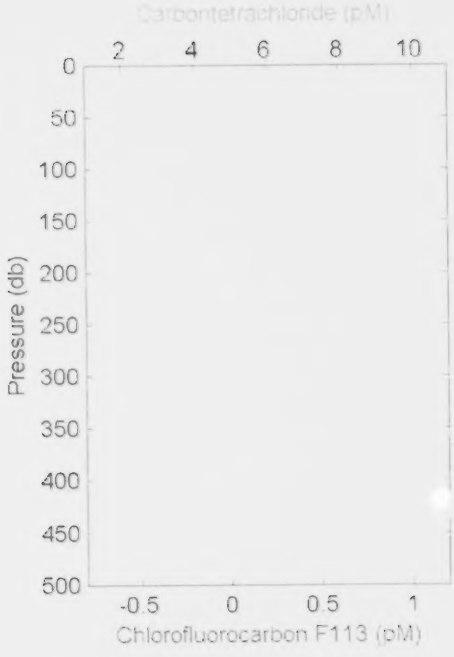


1999-24: Cast 97 Station JB1

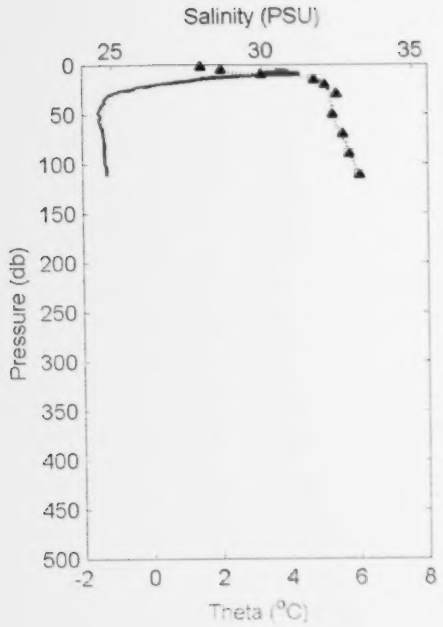


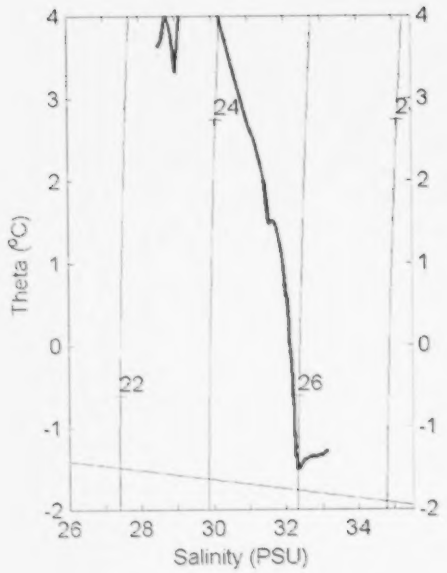


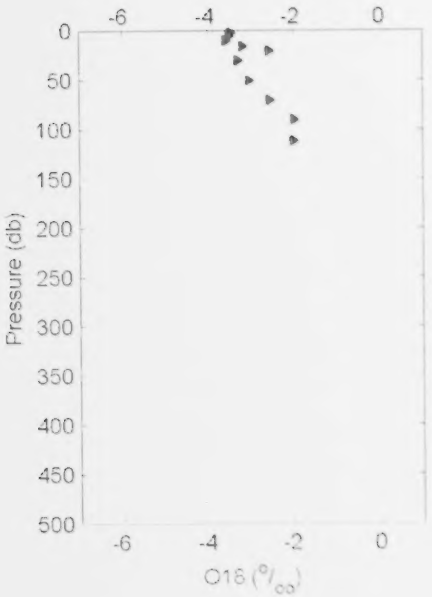


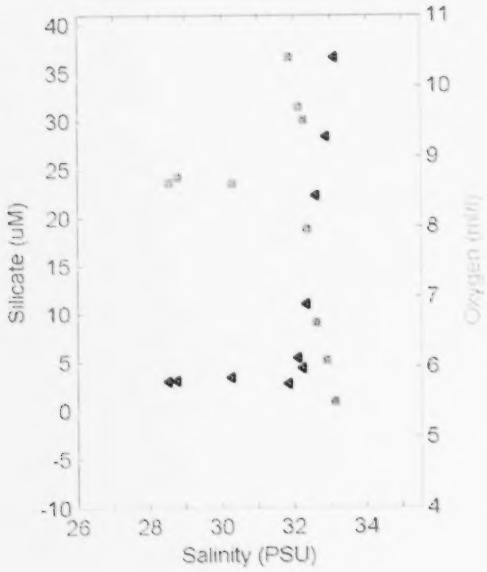


1999-24: Cast 99 Station JB3

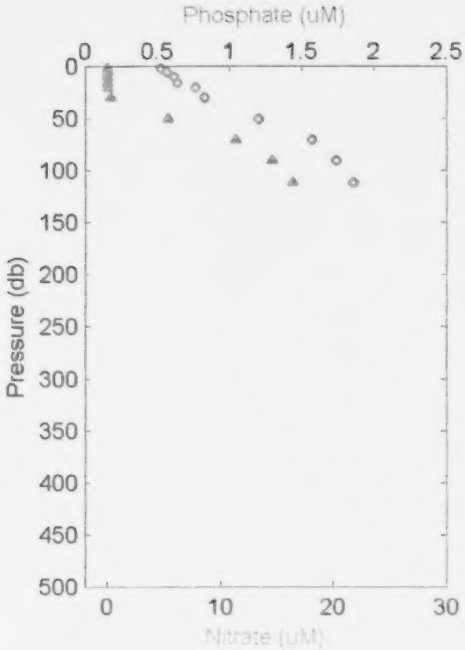


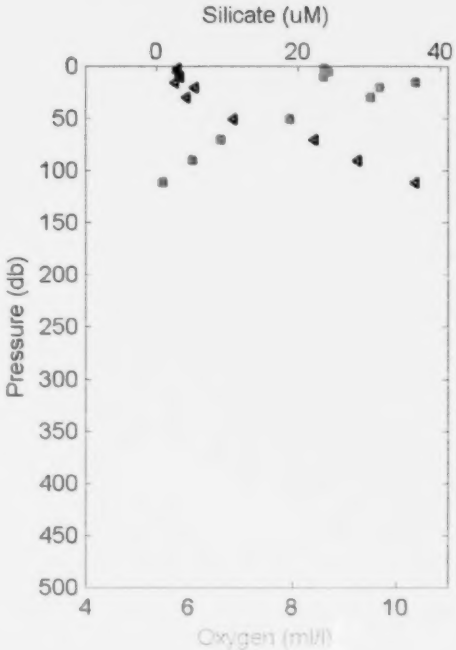


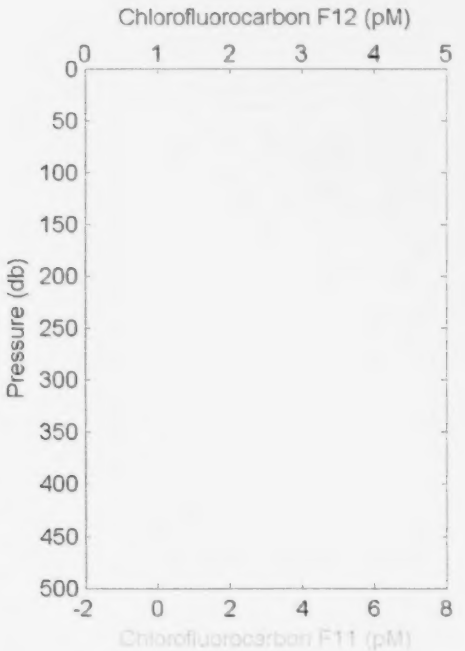


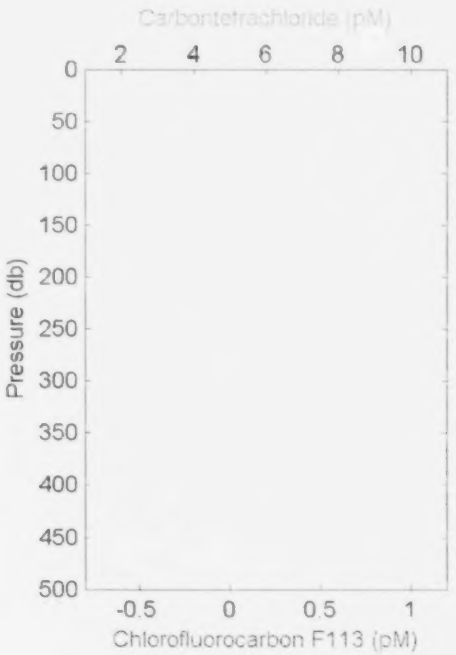


1999-24: Cast 99 Station JB3

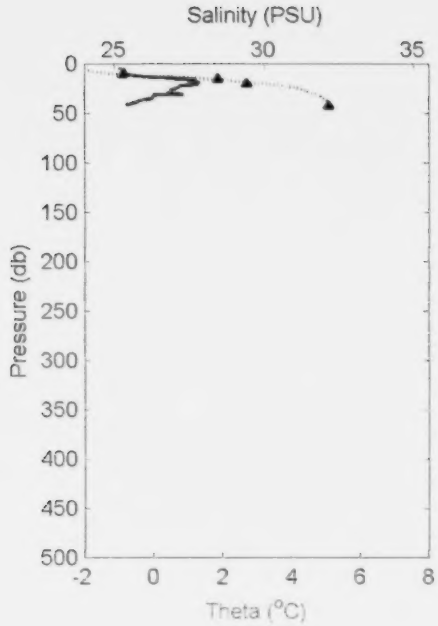


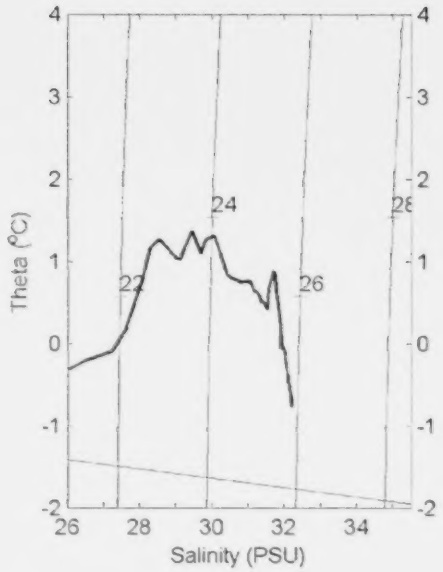


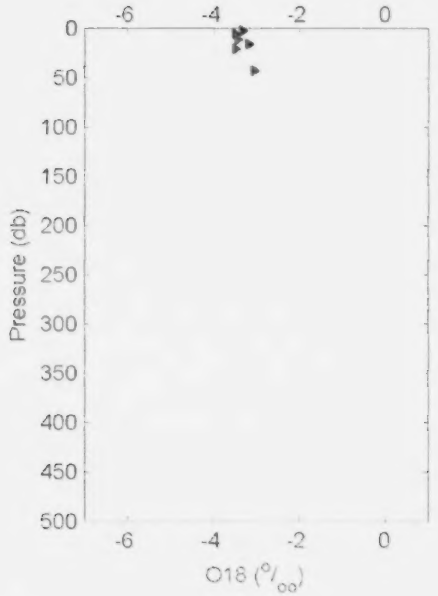


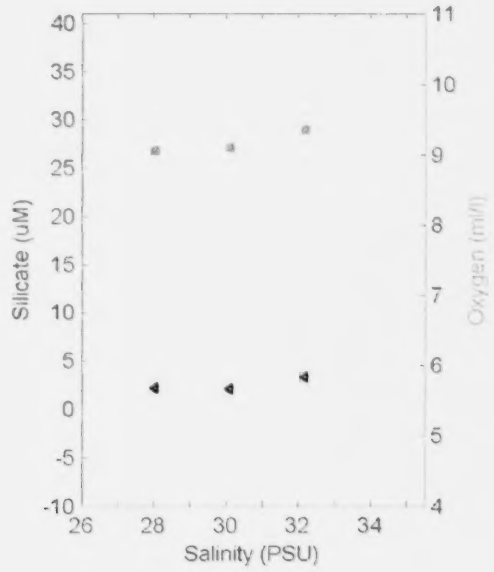


1999-24: Cast 101 Station JB5

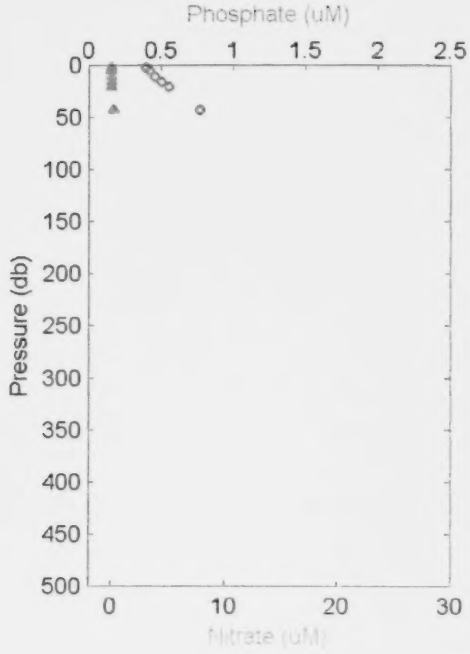


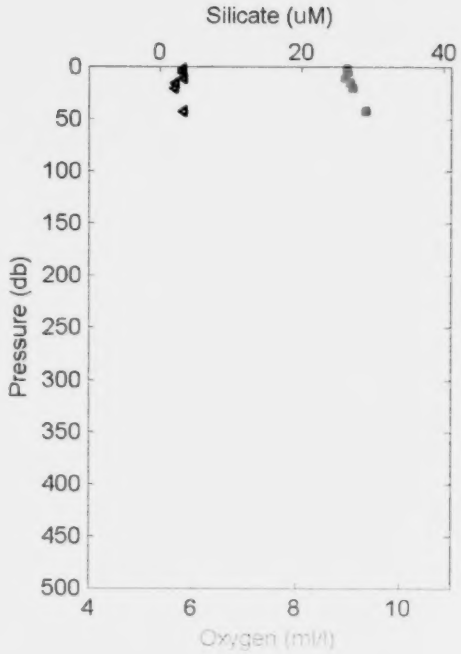


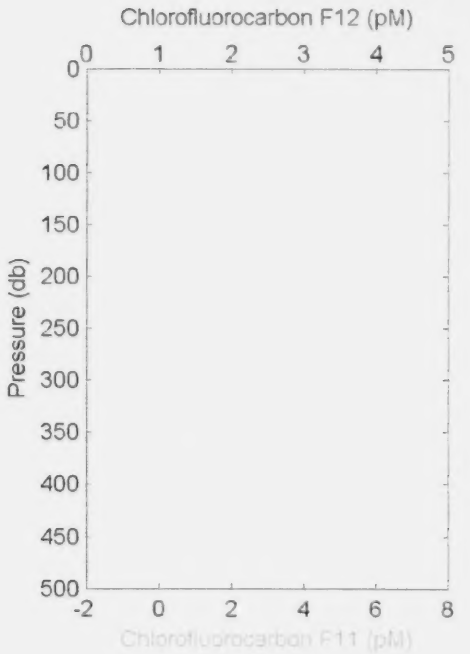


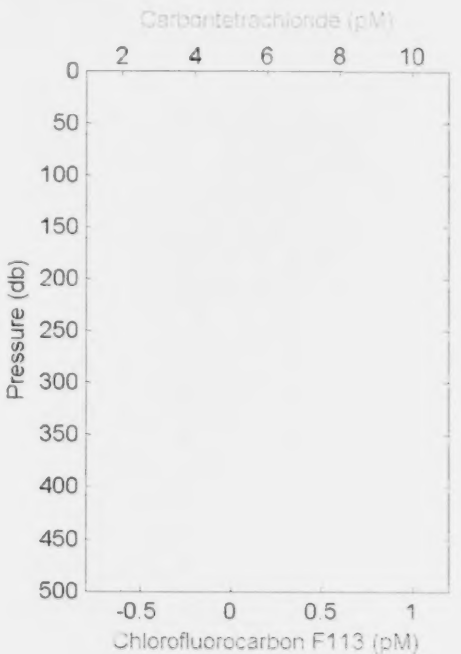


1999-24: Cast 101 Station JB5





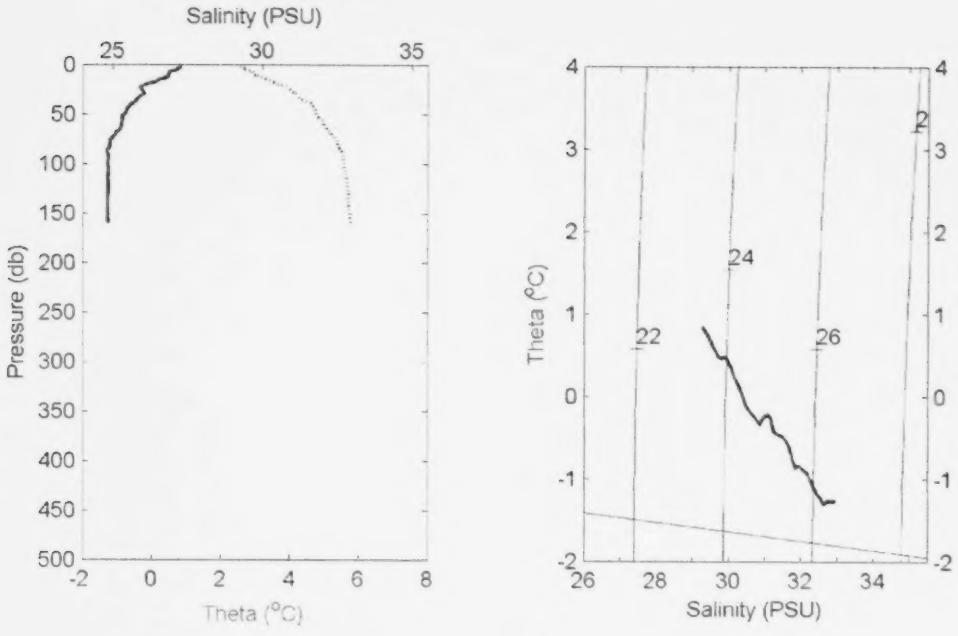




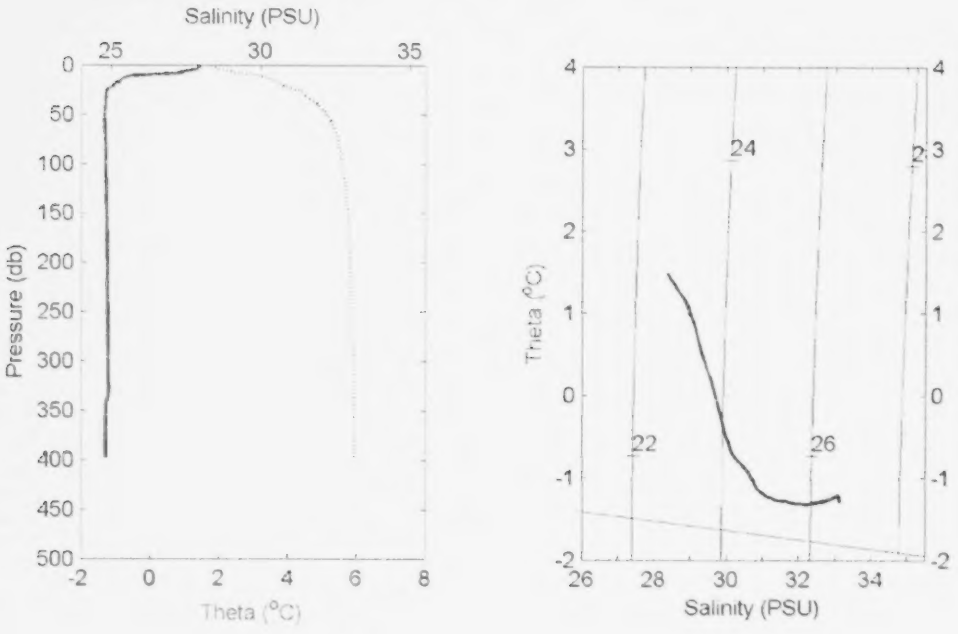
4.4.2 CTD Only

1999-24: CTD Casts

Cast 23 Station FT6

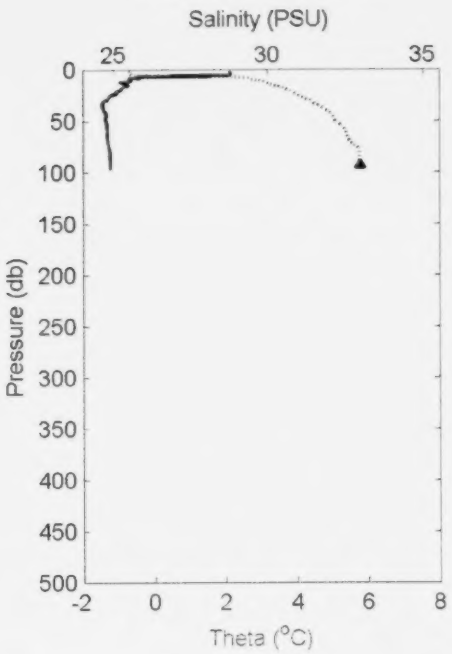


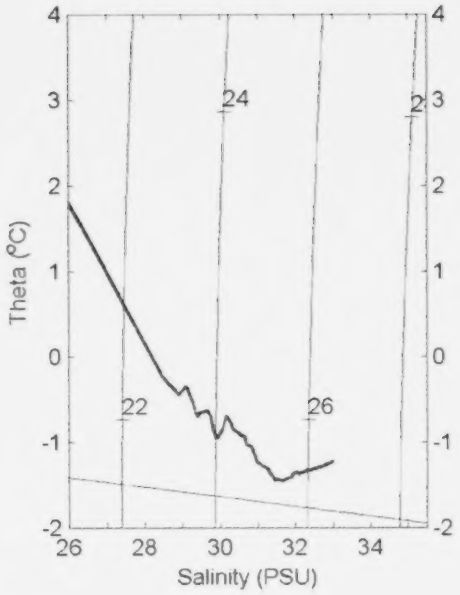
Cast 38 Station PS1



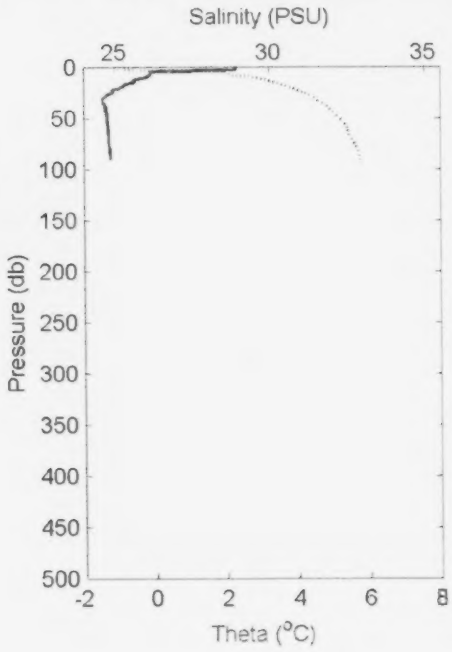
1999-24: CTD Casts

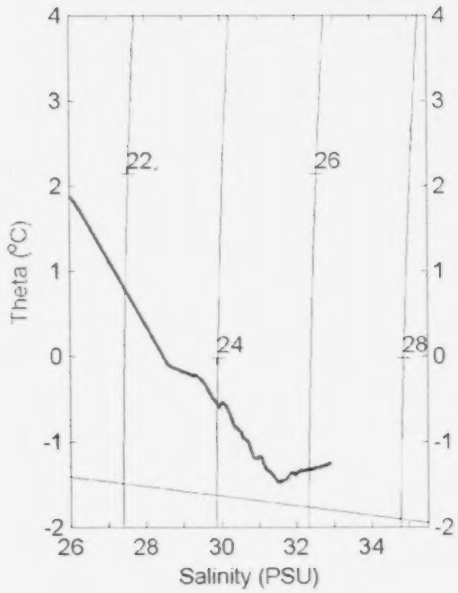
Cast 39 Station JR1





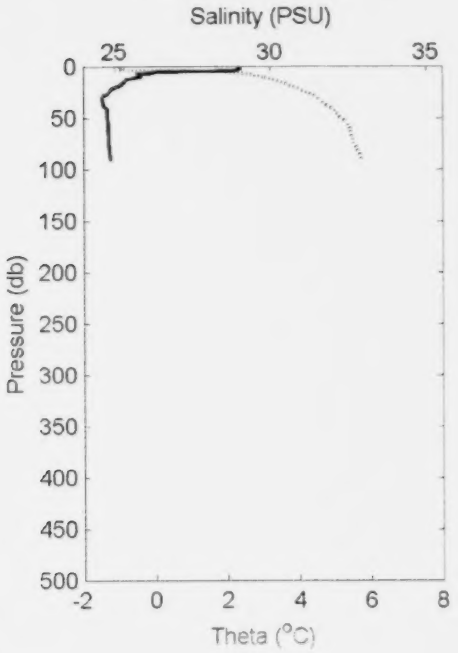
Cast 40 Station JR2

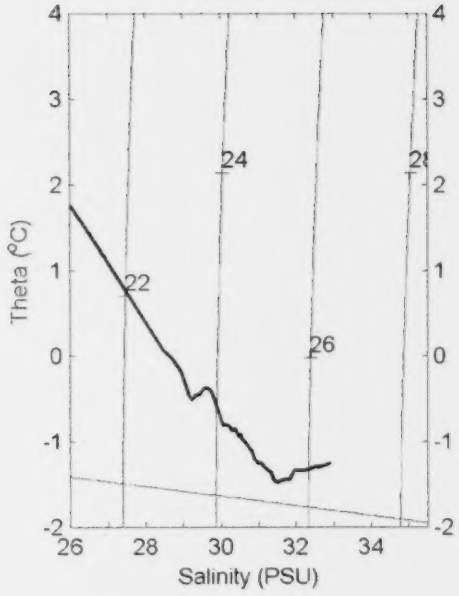




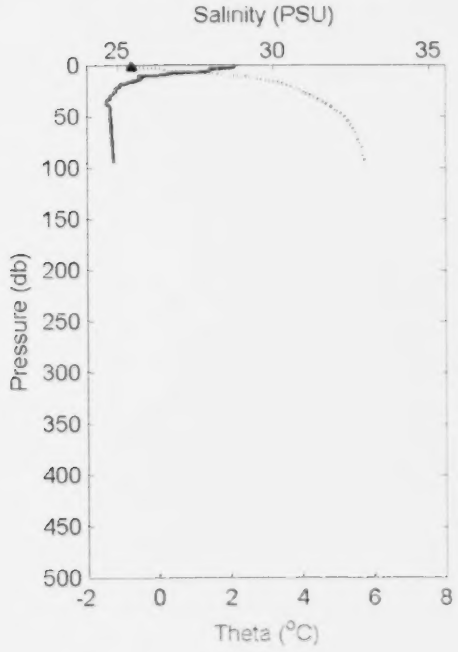
1999-24: CTD Casts

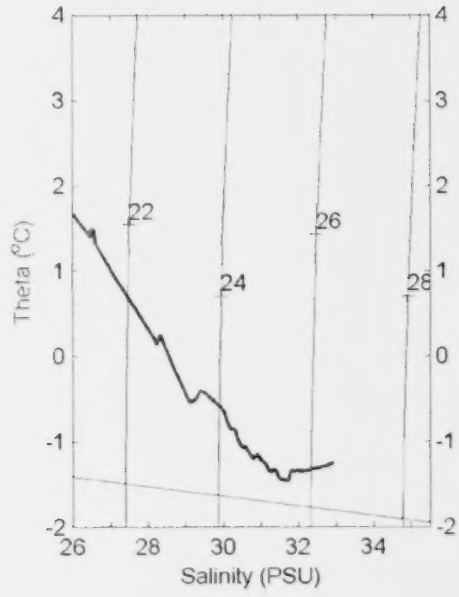
Cast 41 Station JR3





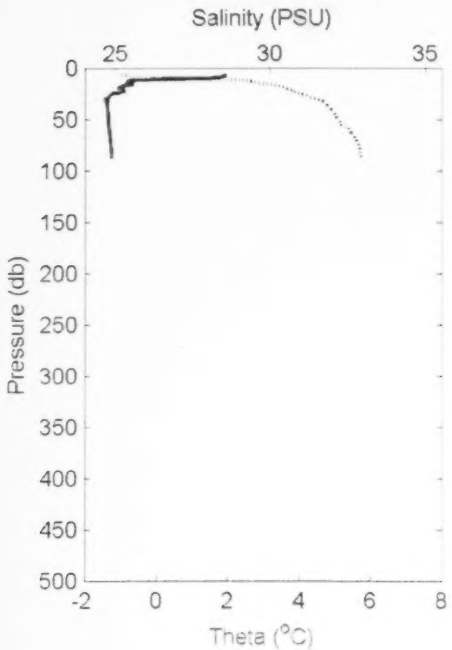
Cast 43 Station JR4

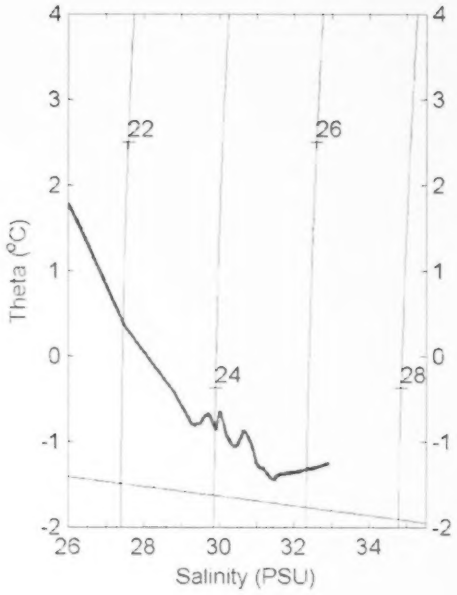




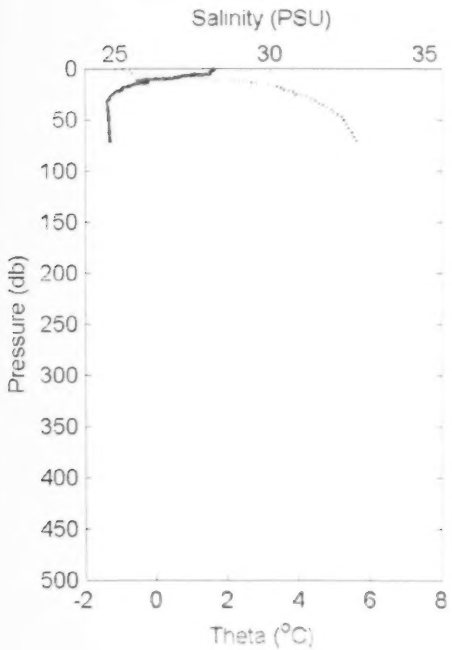
1999-24: CTD Casts

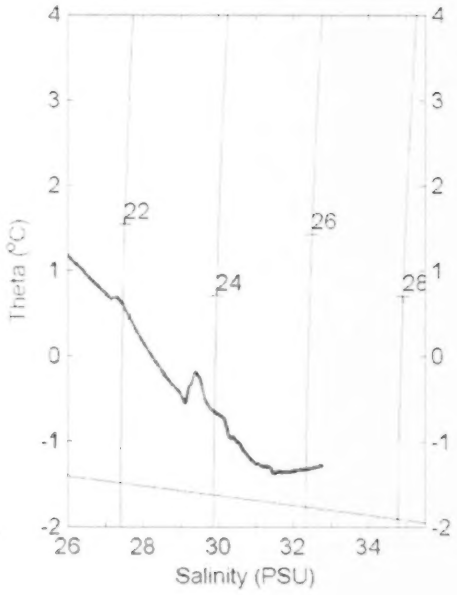
Cast 45 Station JRL1





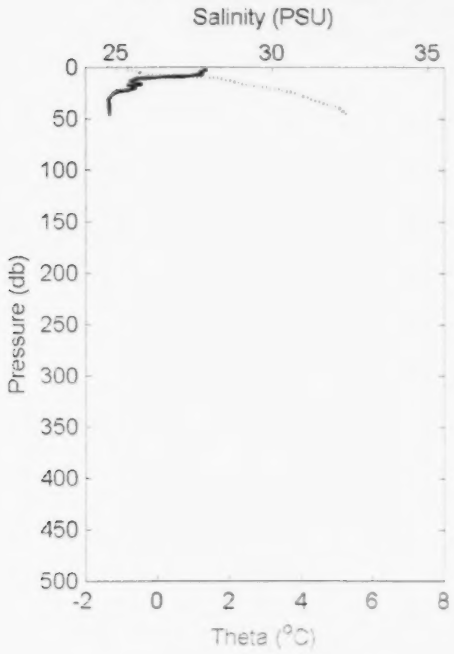
Cast 46 Station JRL2

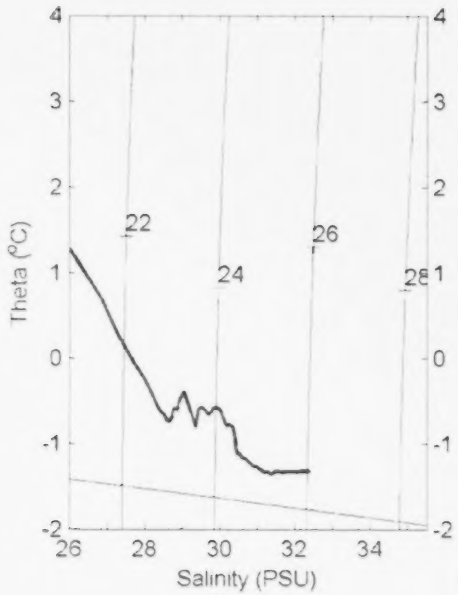




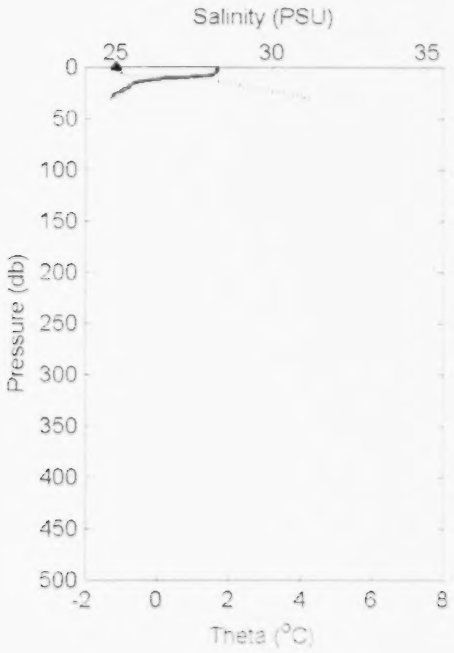
1999-24: CTD Casts

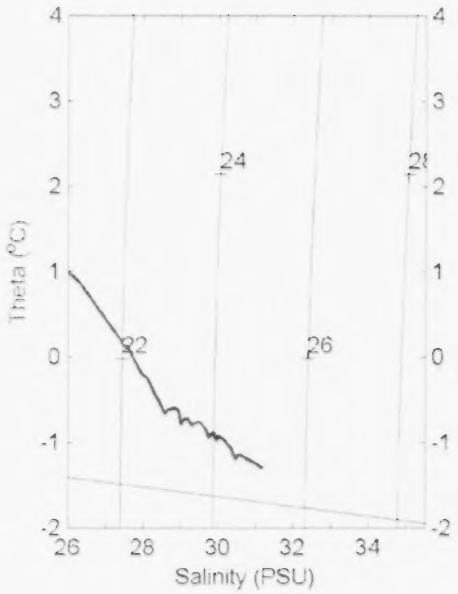
Cast 47 Station JRL3





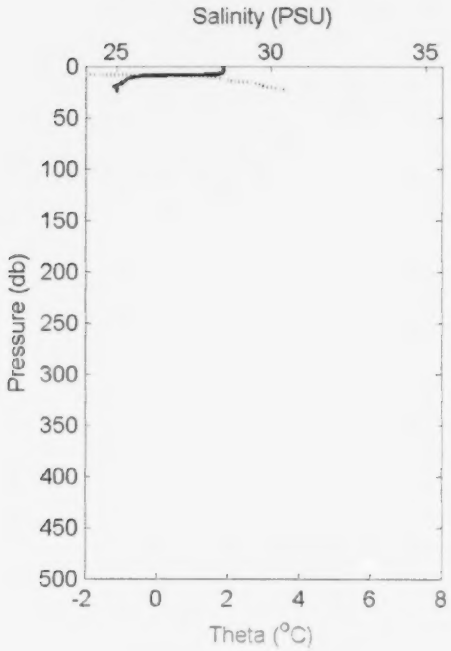
Cast 48 Station JRL4

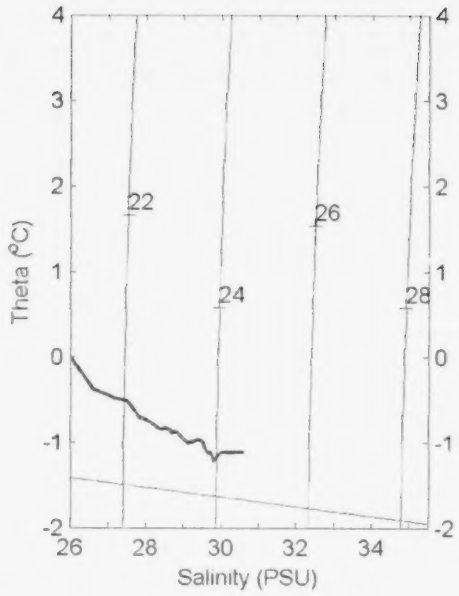




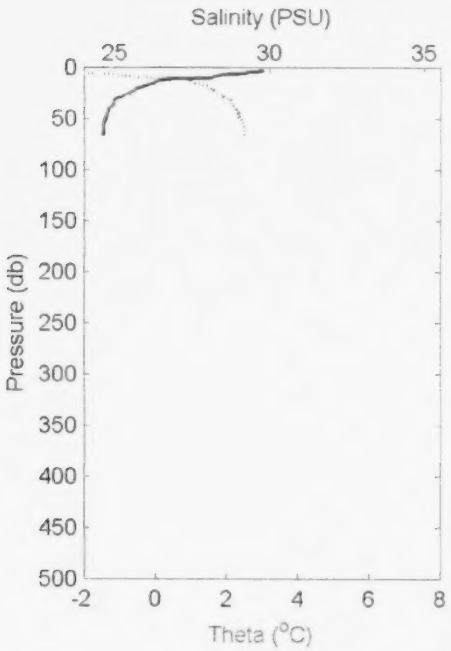
1999-24: CTD Casts

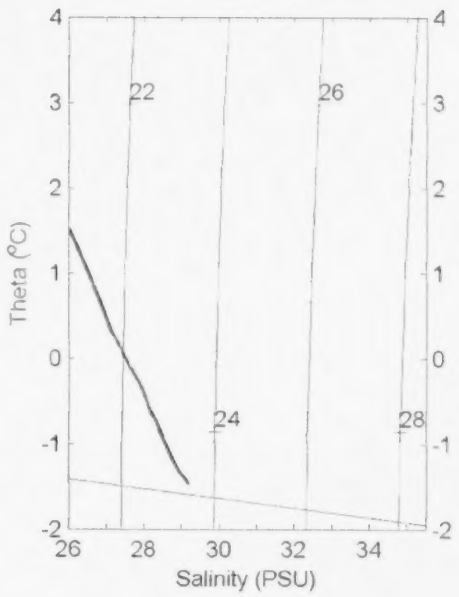
Cast 50 Station JR7



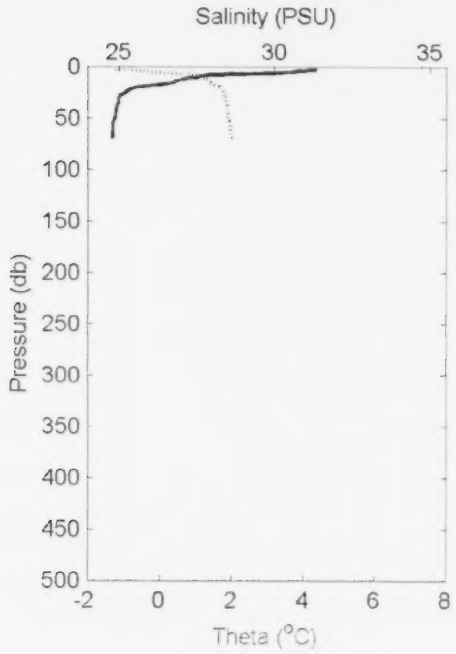


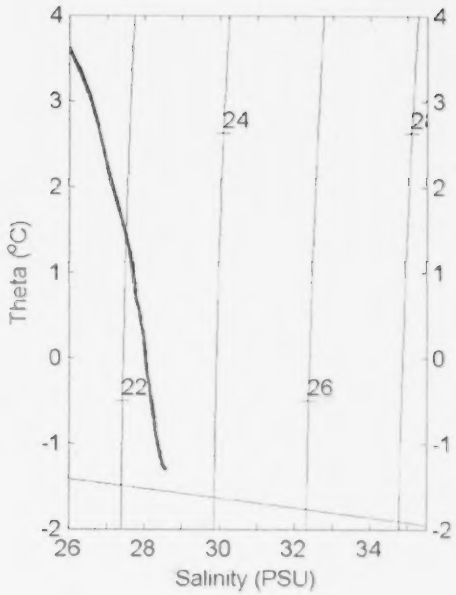
Cast 51 Station QM1



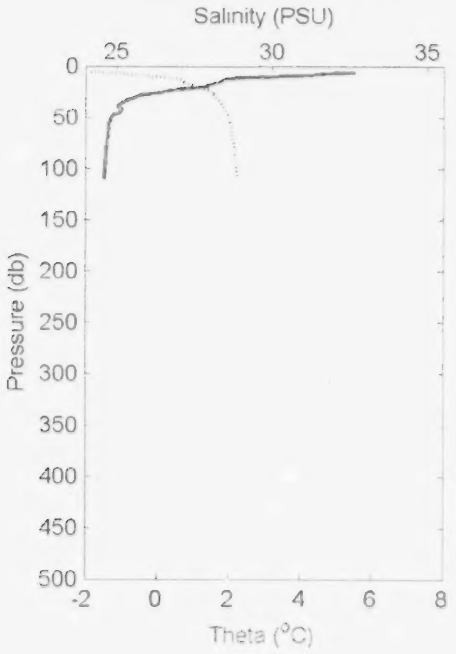


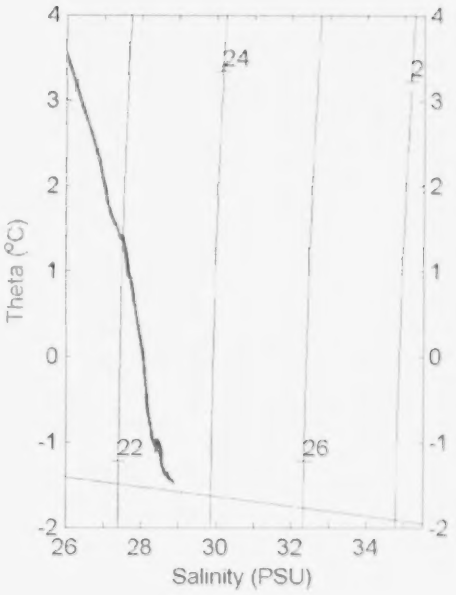
Cast 54 Station TP2





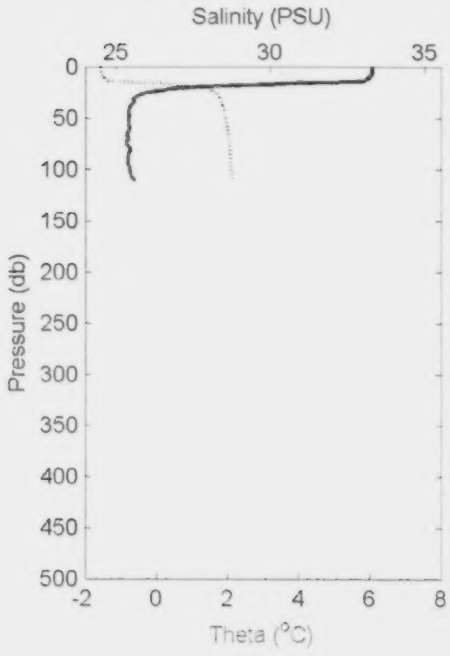
Cast 56 Station TP4

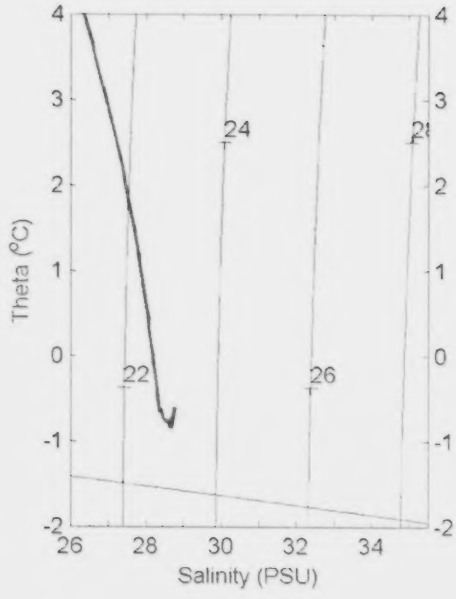




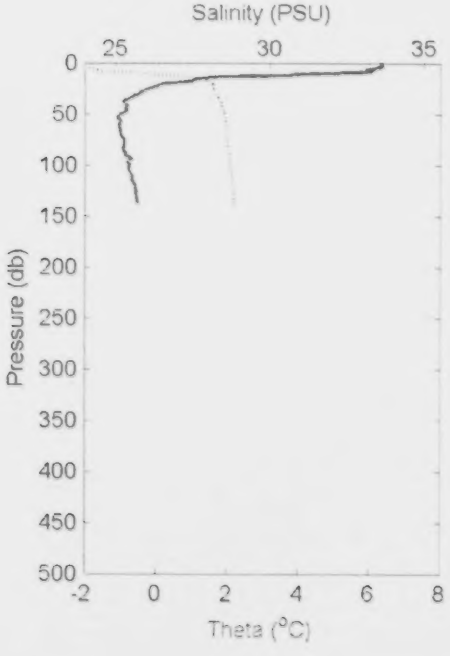
1999-24: CTD Casts

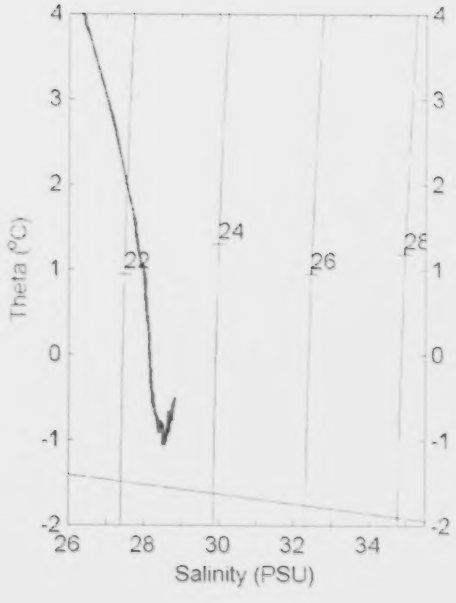
Cast 59 Station EI2



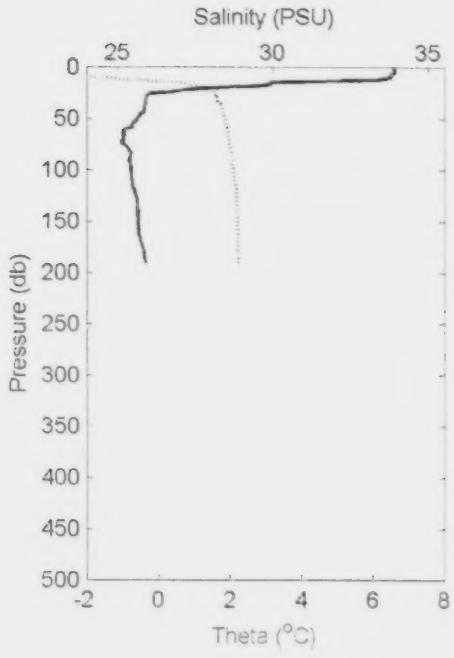


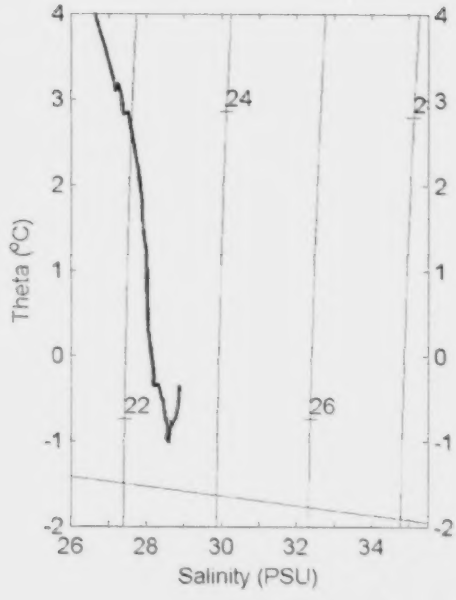
Cast 60 Station EI3



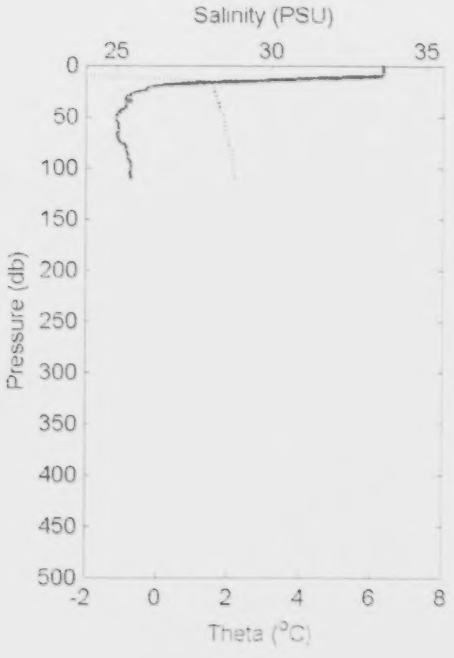


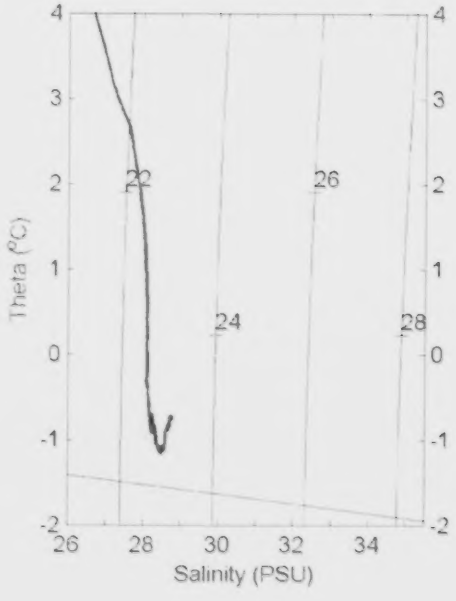
Cast 61 Station EI4





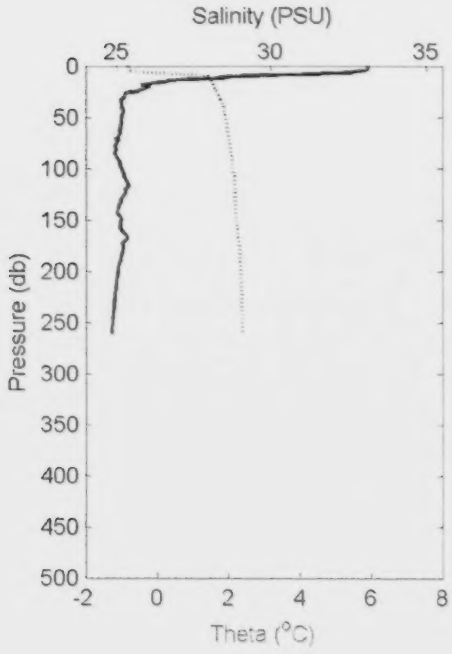
Cast 63 Station EI6

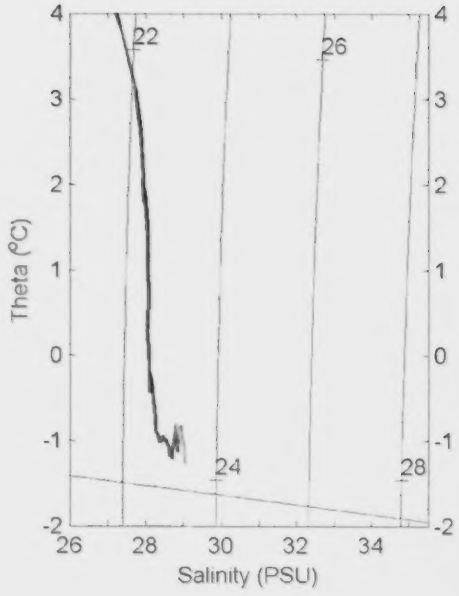




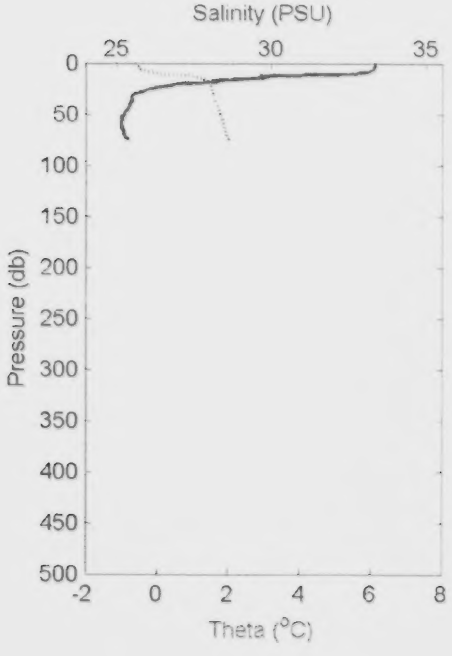
1999-24: CTD Casts

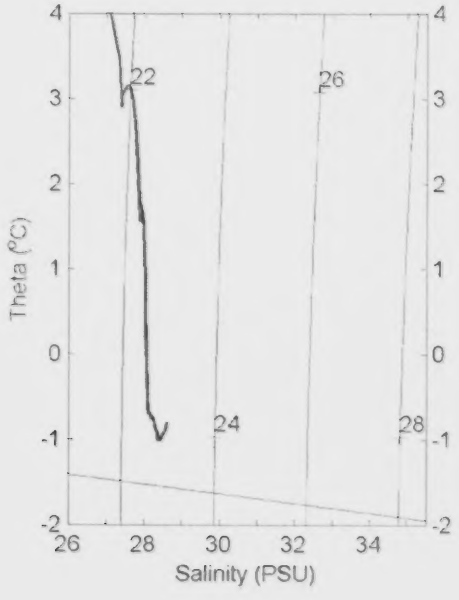
Cast 68 Station EI8



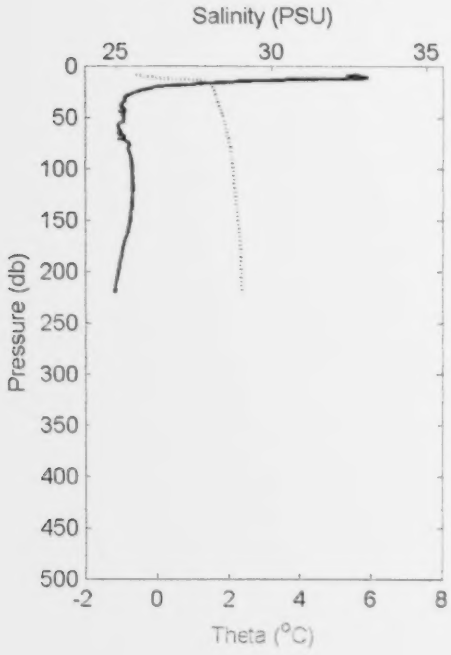


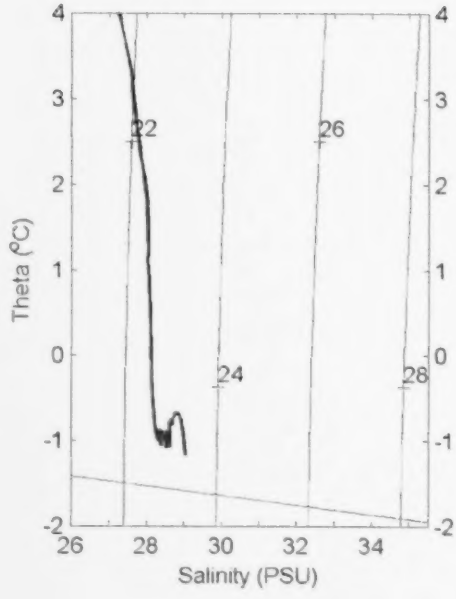
Cast 71 Station EI11



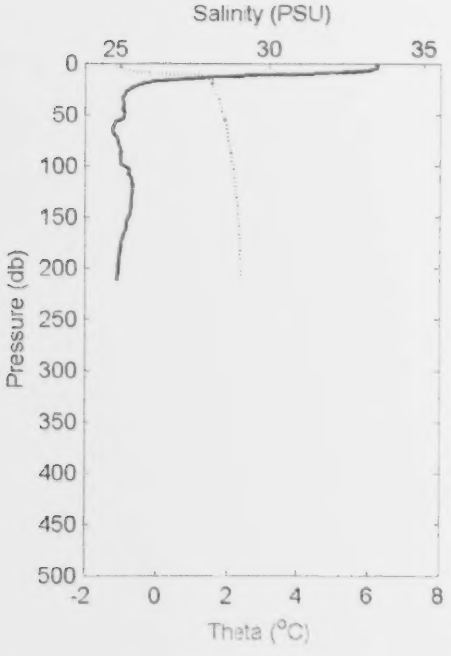


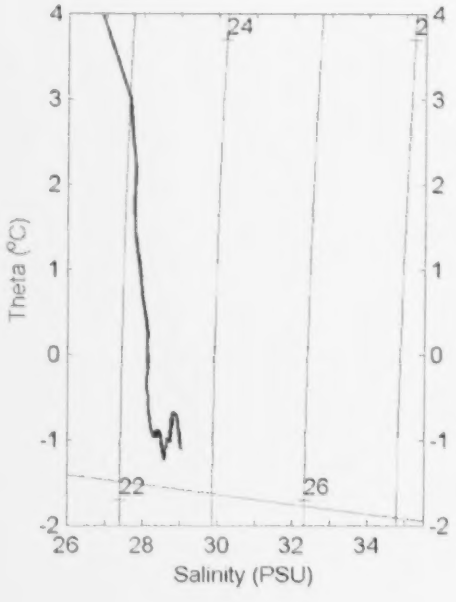
Cast 72 Station EI16





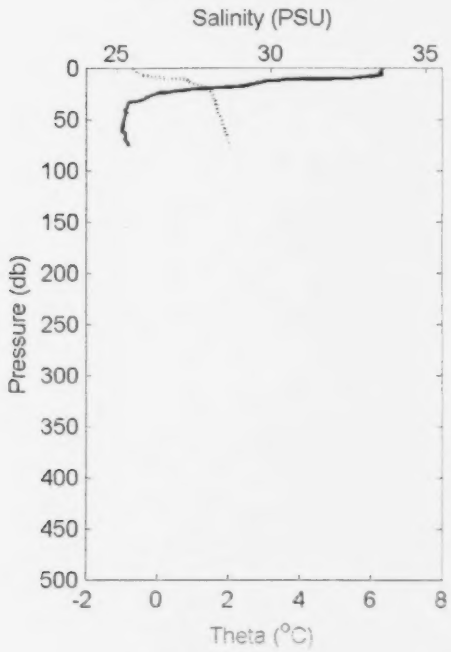
Cast 74 Station EI17

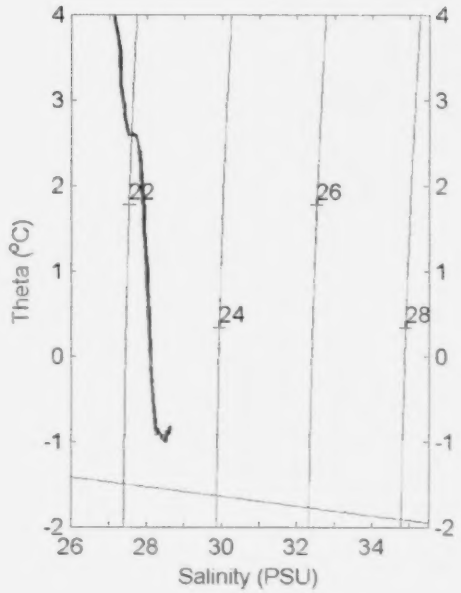




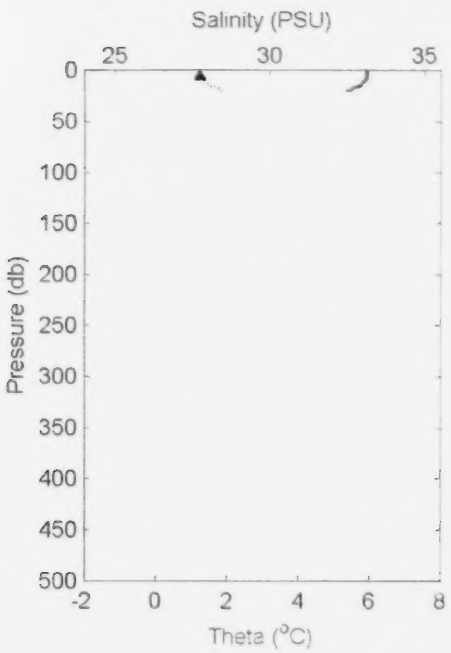
1999-24: CTD Casts

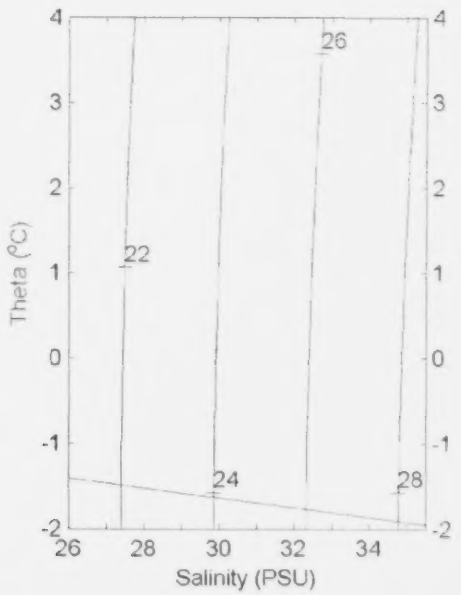
Cast 75 Station EI18





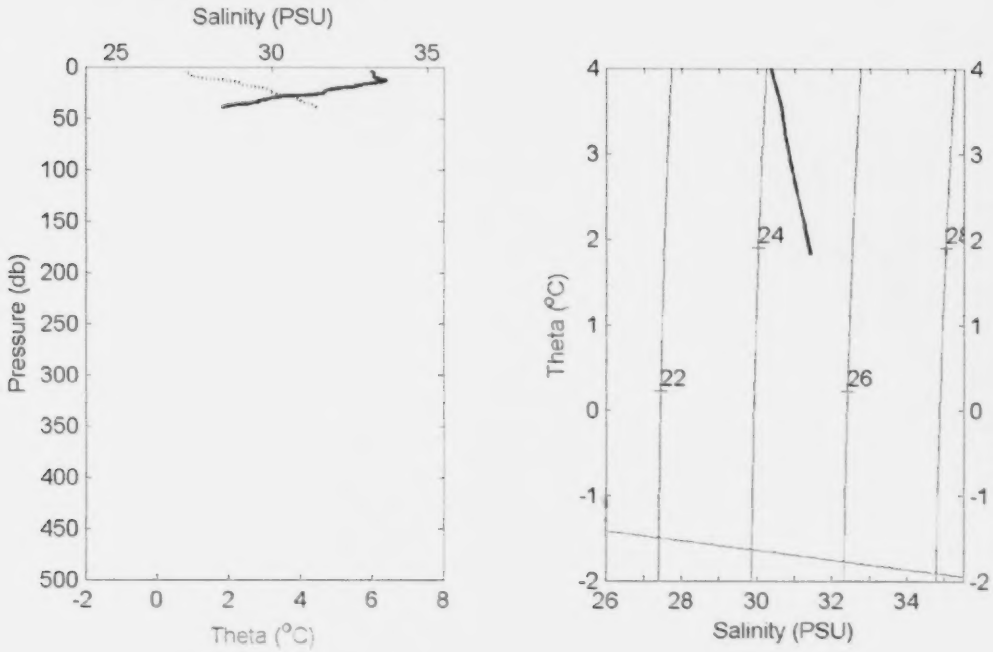
Cast 76 Station CI1



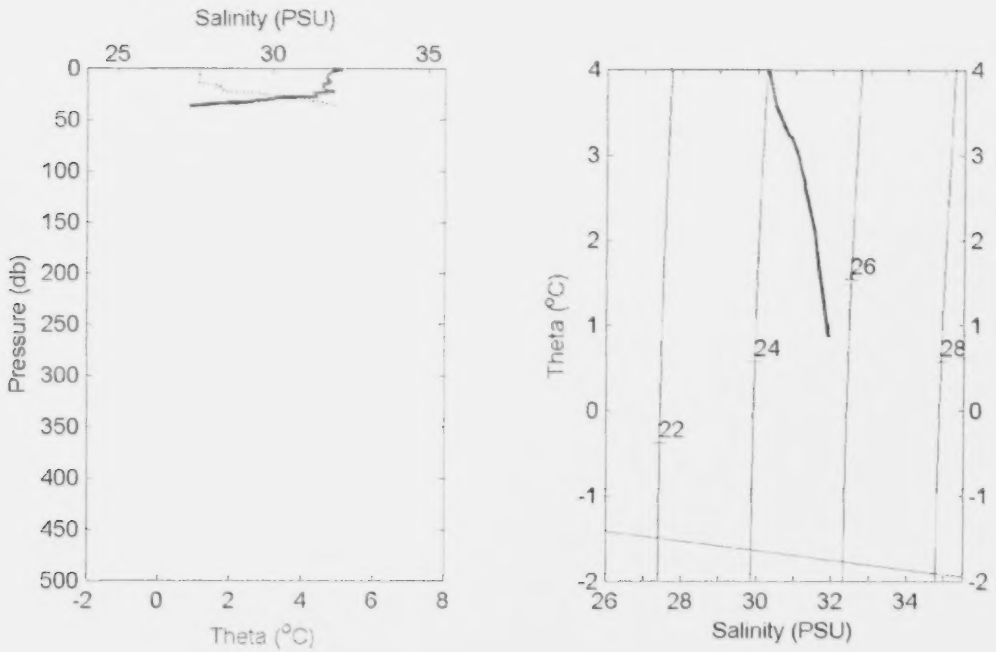


1999-24: CTD Casts

Cast 77 Station CI2

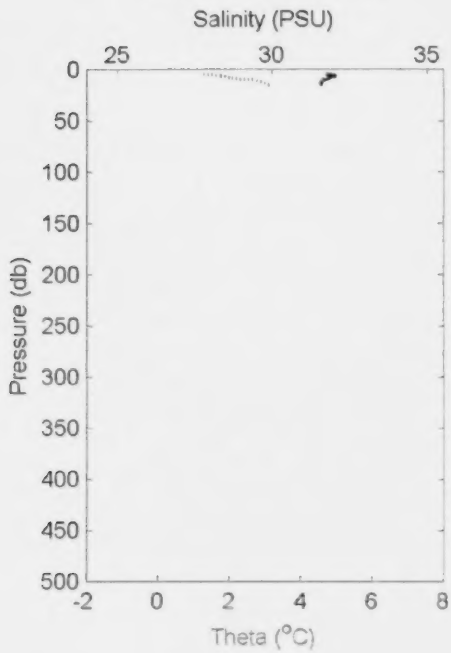


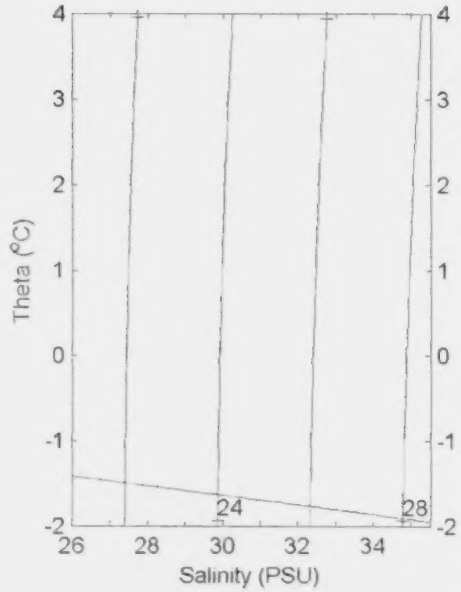
Cast 80 Station CI4



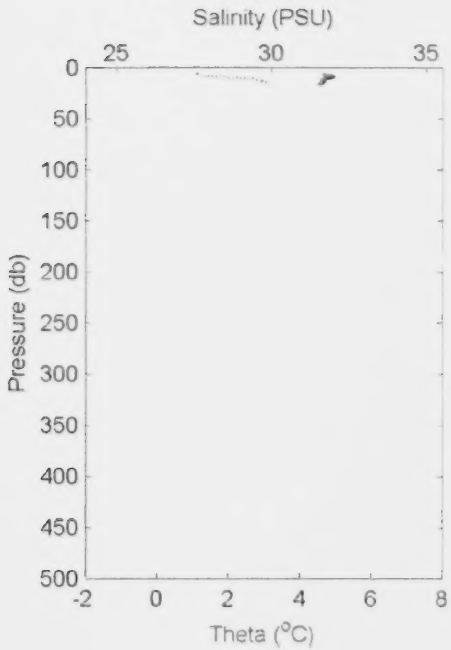
1999-24: CTD Casts

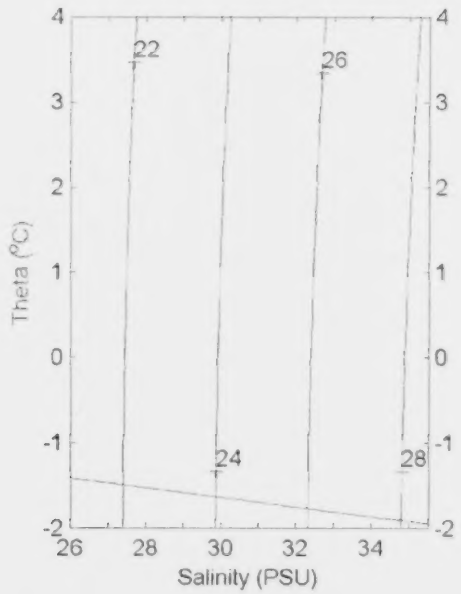
Cast 81 Station CI5





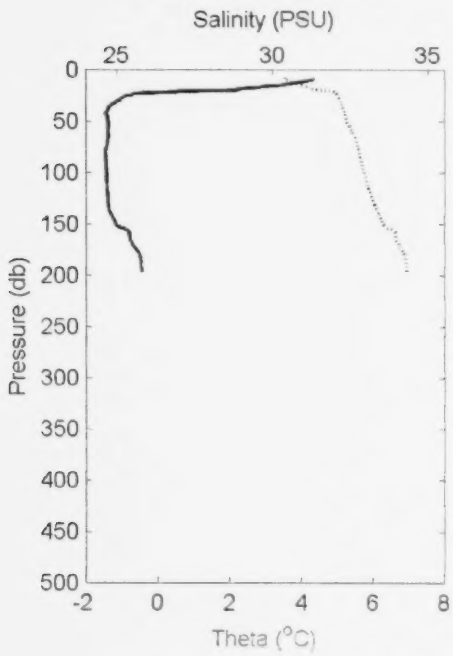
Cast 82 Station CI5

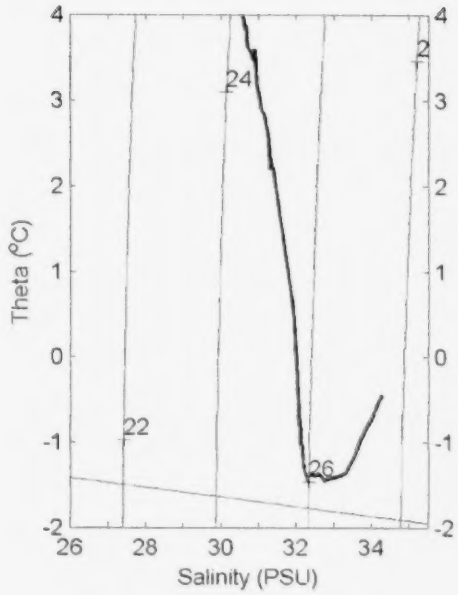




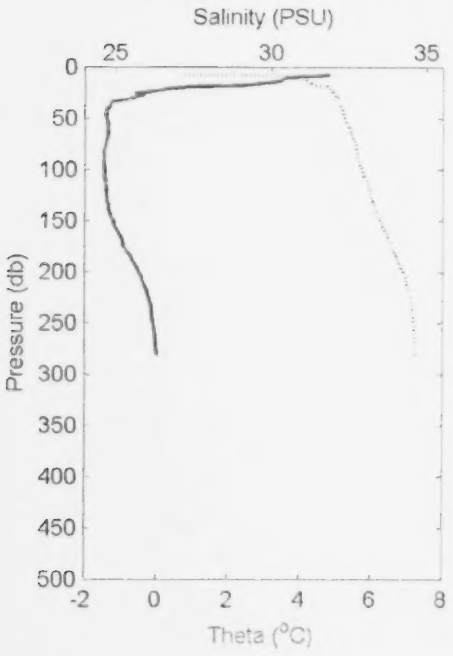
1999-24: CTD Casts

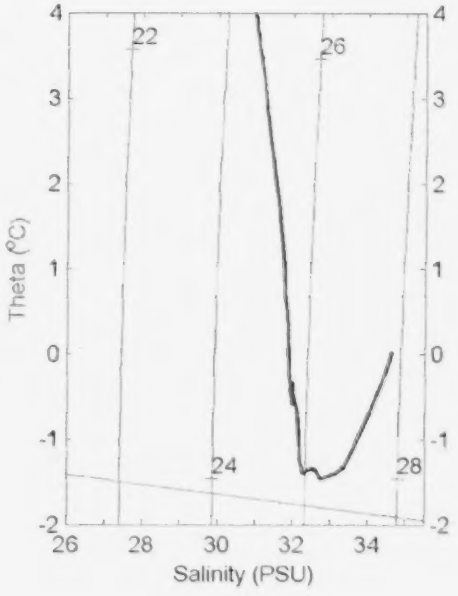
Cast 84 Station AG2



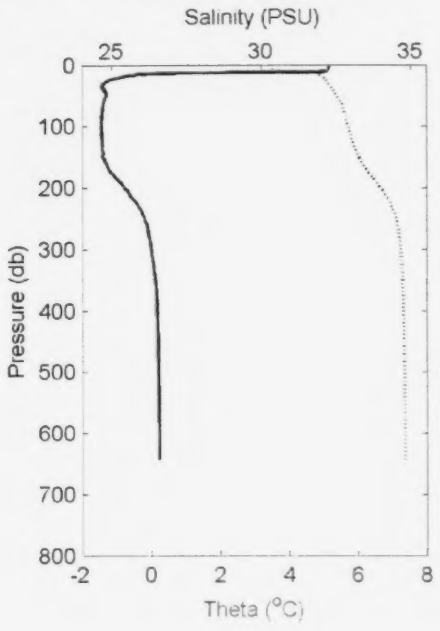


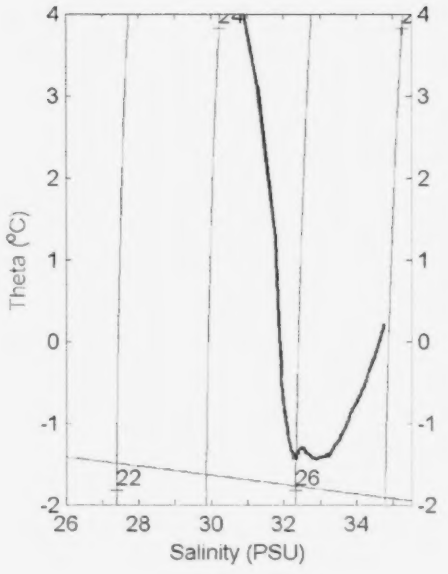
Cast 86 Station AG3



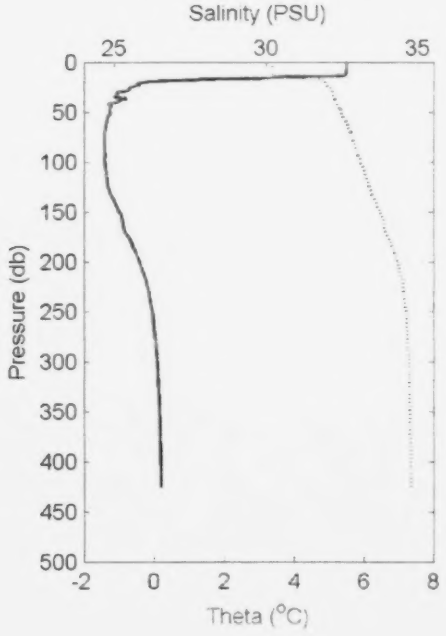


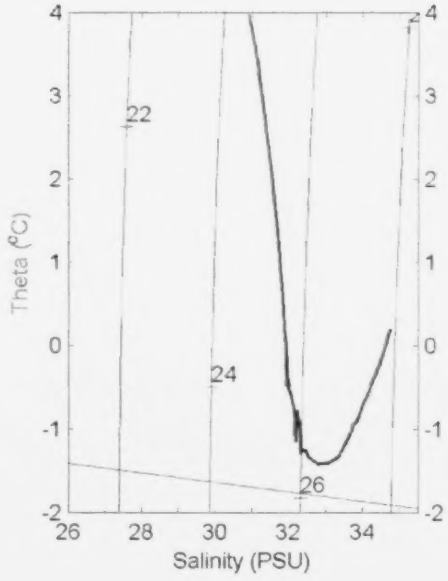
Cast 88 Station AG5





Cast 91 Station AG6





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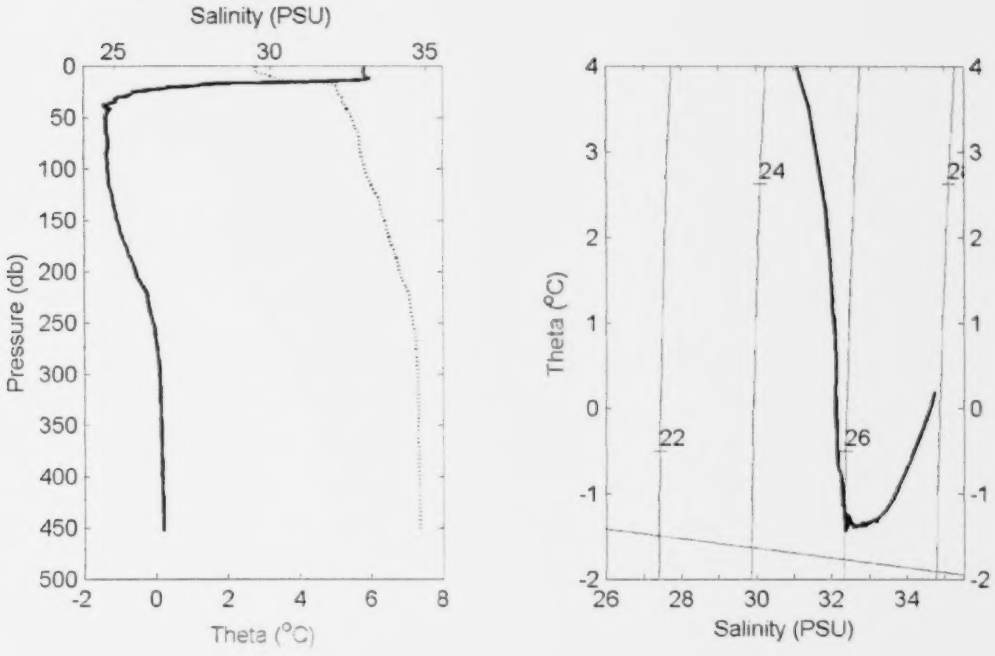
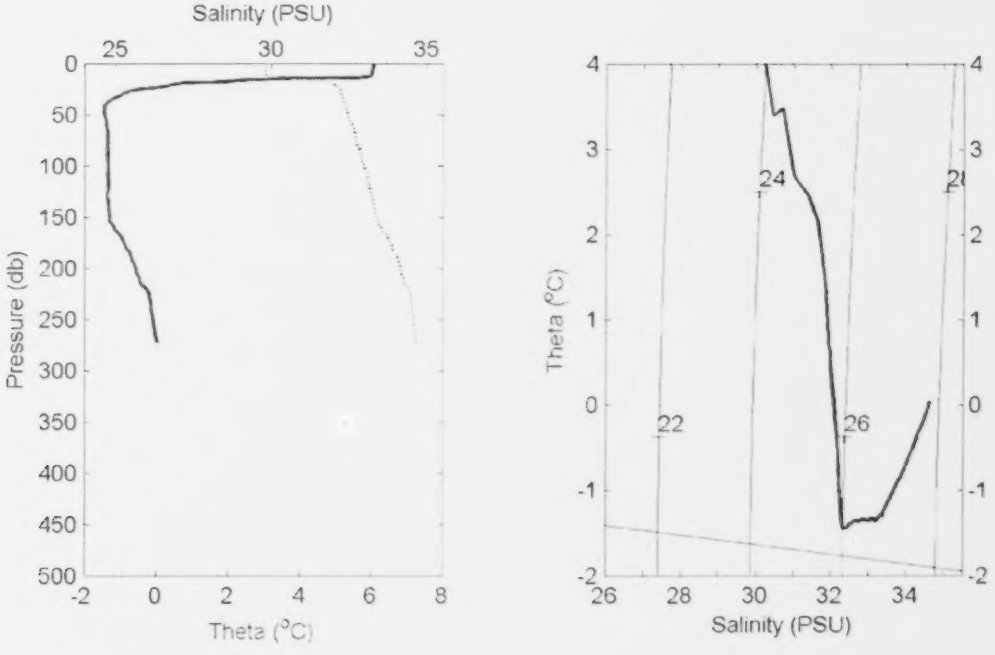
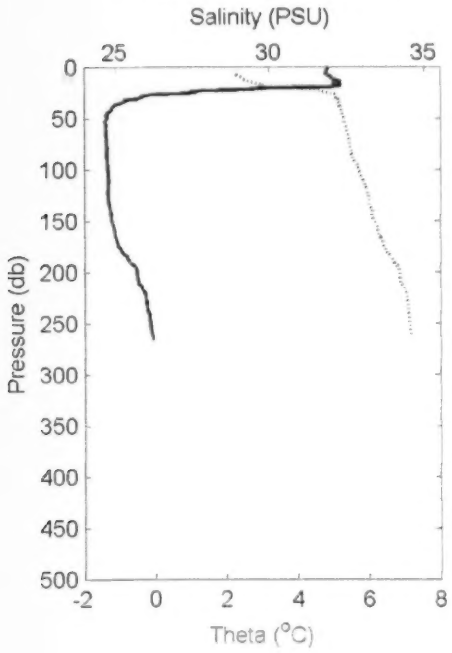


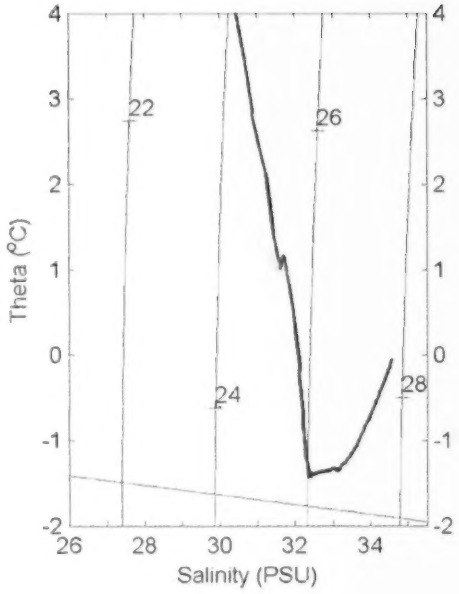
Cast 93 Station AG8



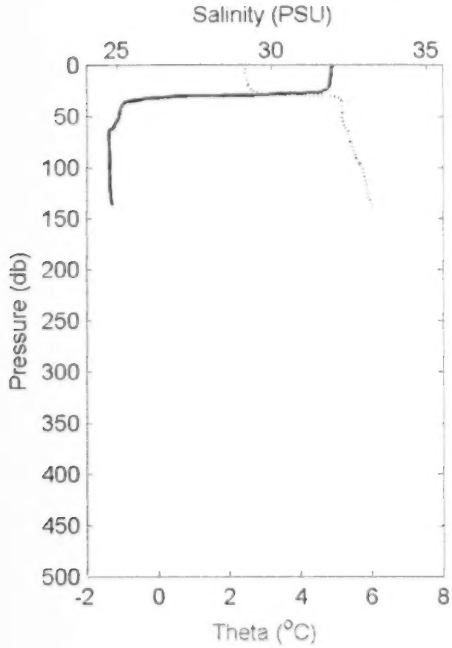
1999-24: CTD Casts

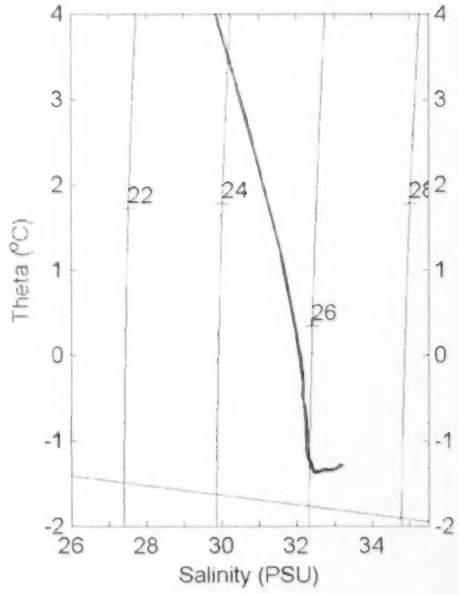
Cast 94 Station AG8b





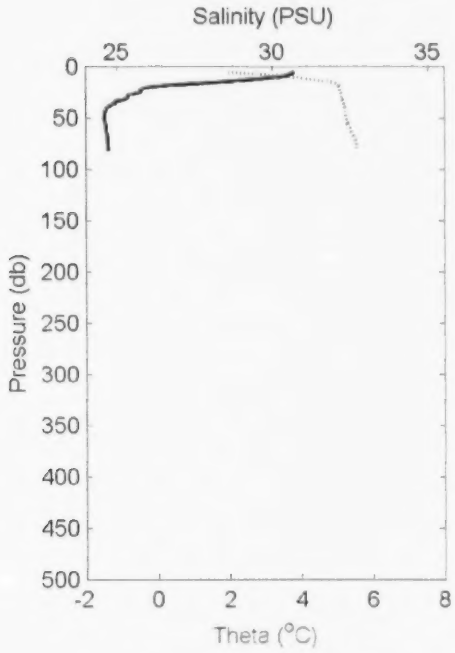
Cast 96 Station AG10

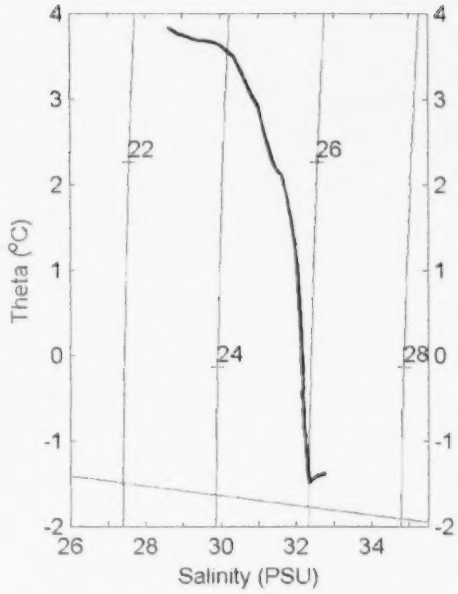




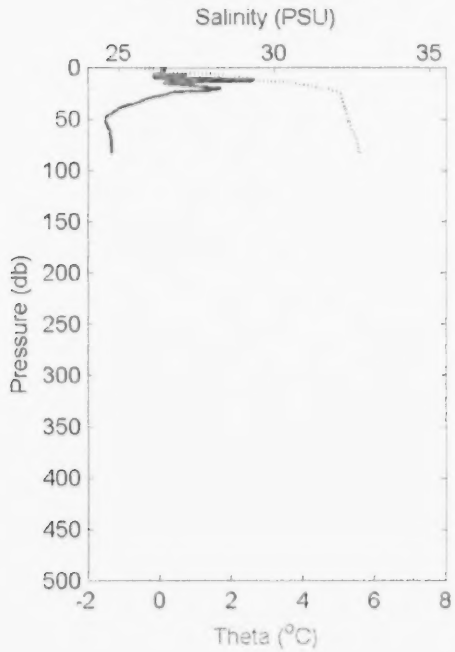
1999-24: CTD Casts

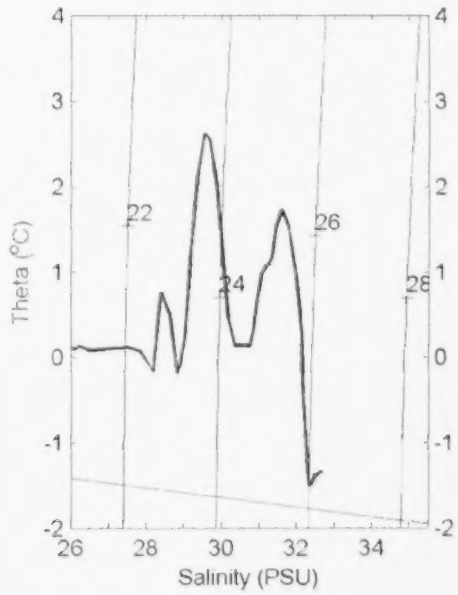
Cast 98 Station JB2





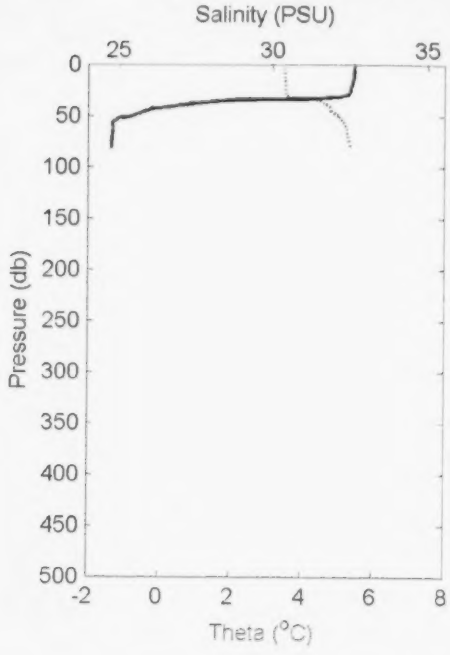
Cast 100 Station JB4

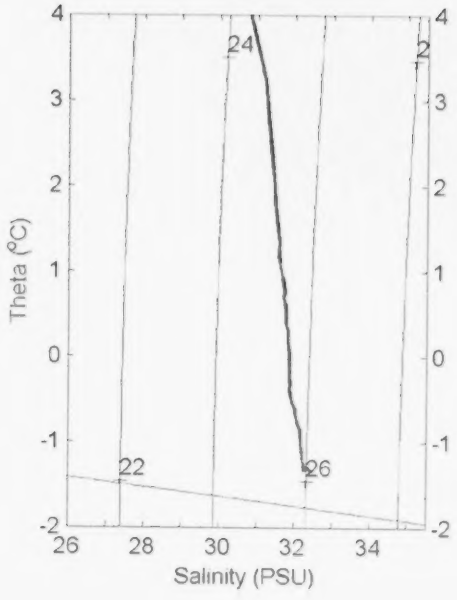




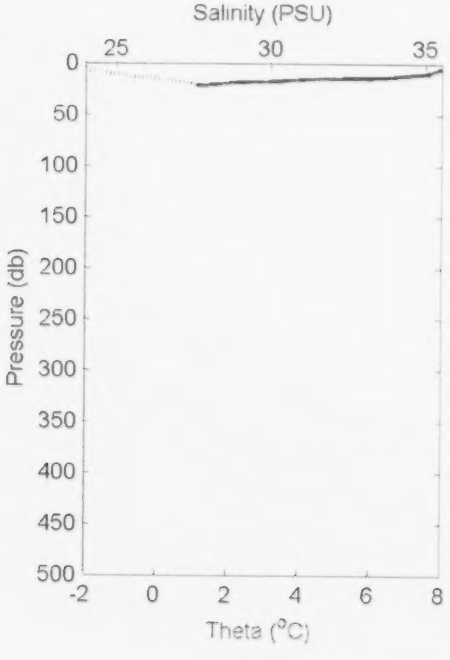
1999-24: CTD Casts

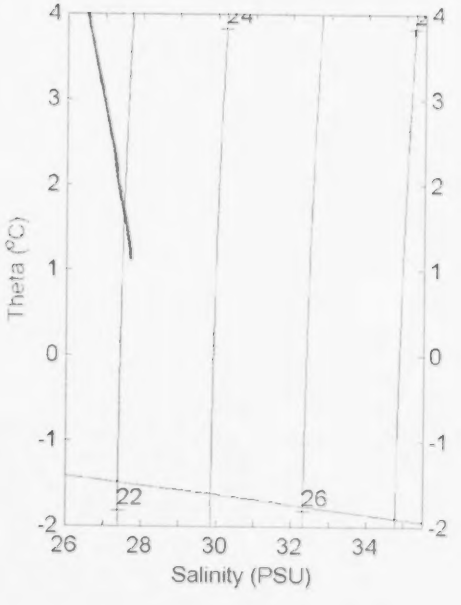
Cast 103 Station TY1





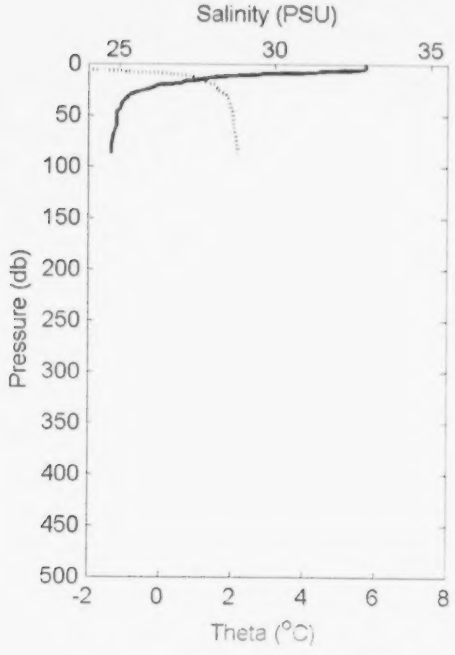
Cast 104 Station CM1

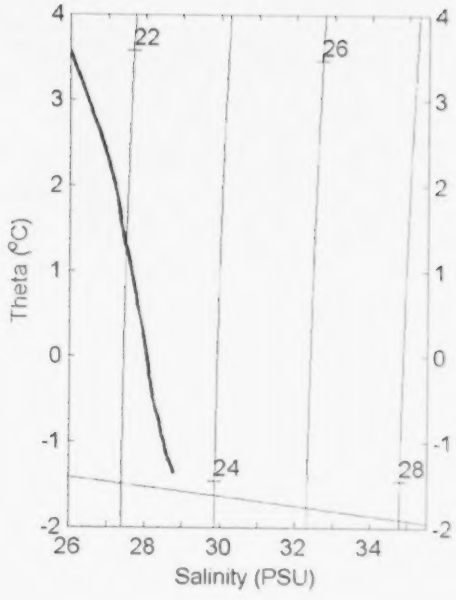




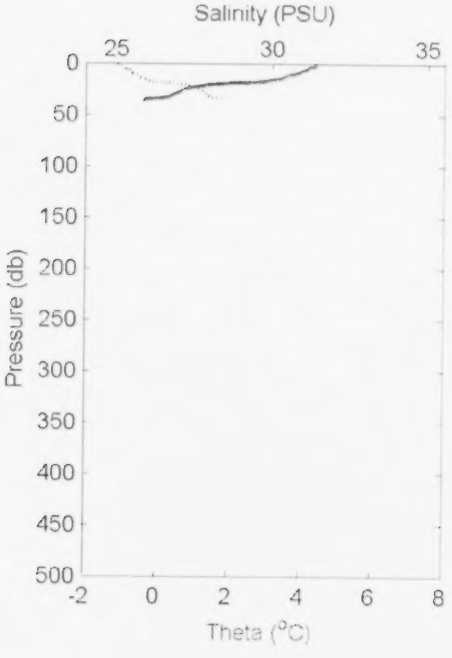
1999-24: CTD Casts

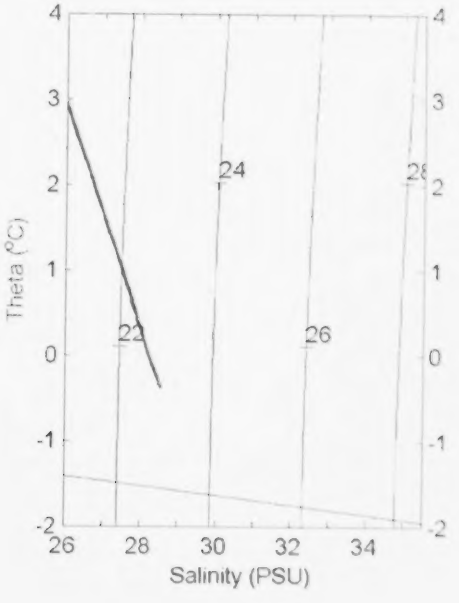
Cast 105 Station SC1





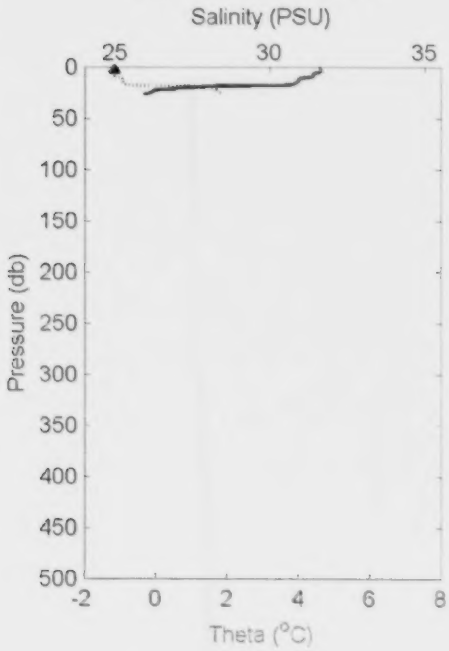
Cast 107 Station CC2

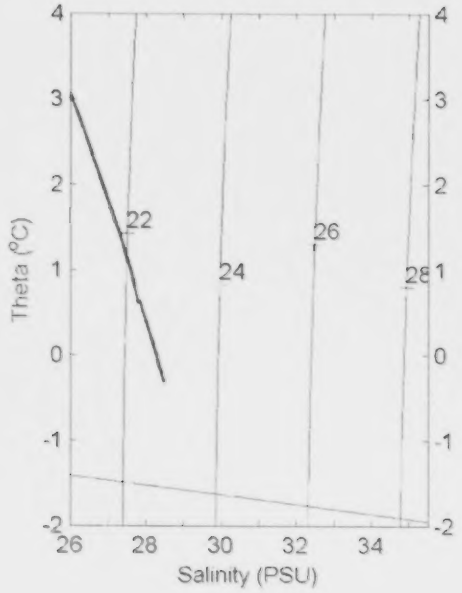




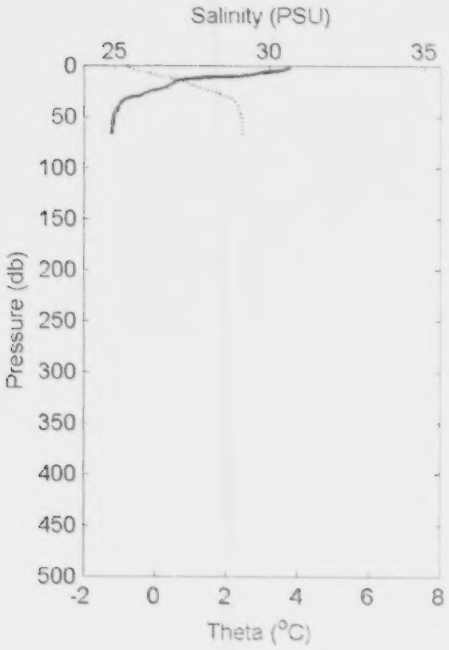
1999-24: CTD Casts

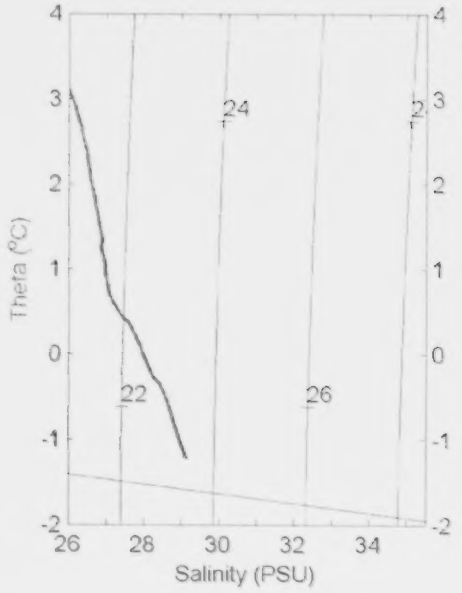
Cast 108 Station CC1





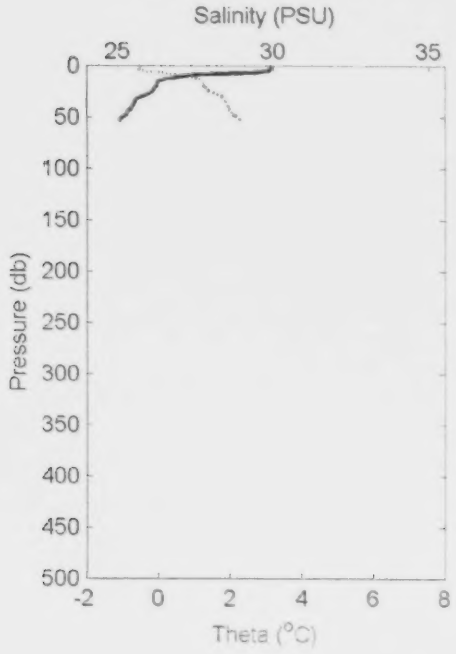
Cast 110 Station CC4

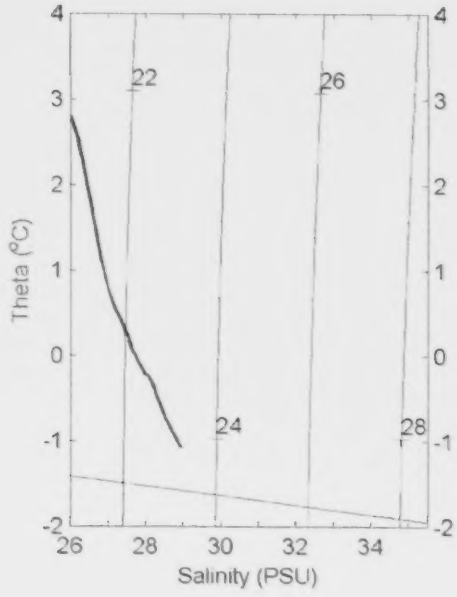




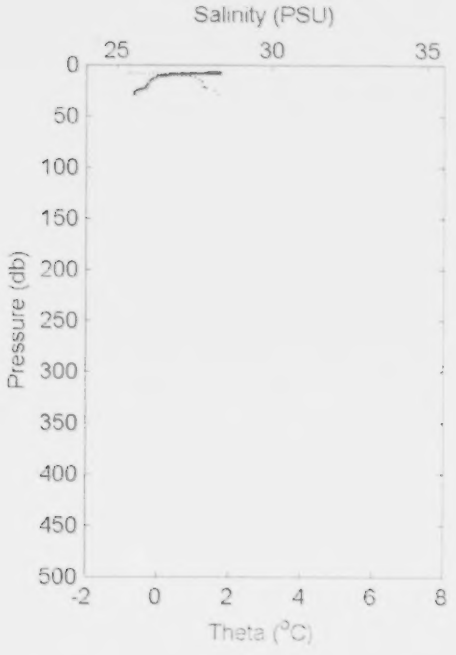
1999-24: CTD Casts

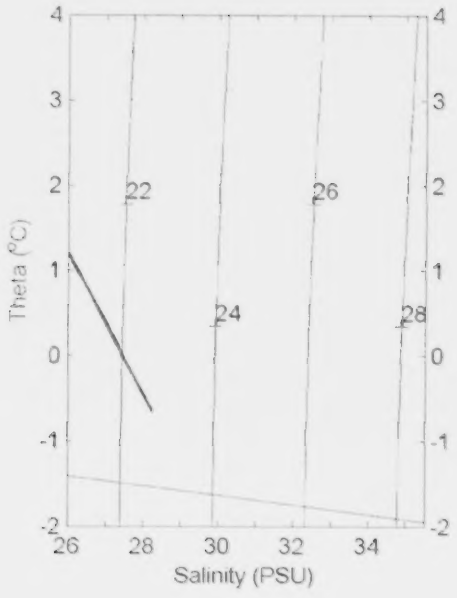
Cast 111 Station CC5





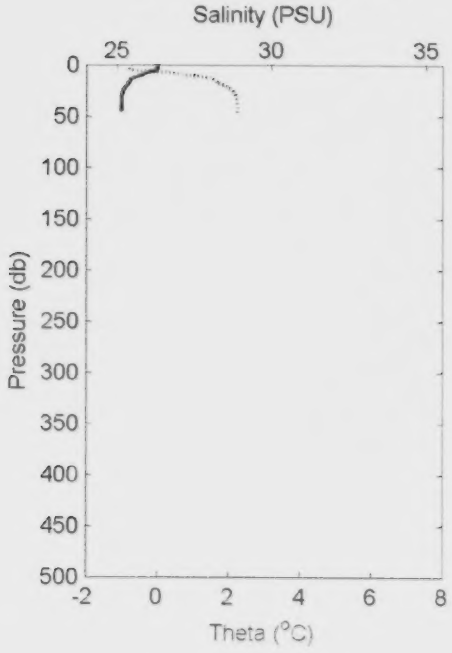
Cast 112 Station JL1

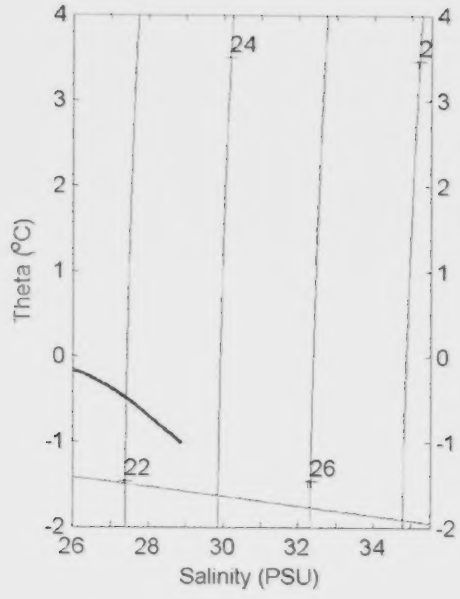




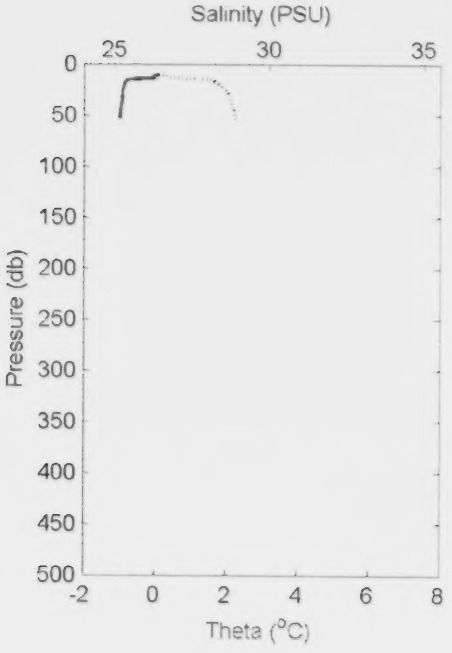
1999-24: CTD Casts

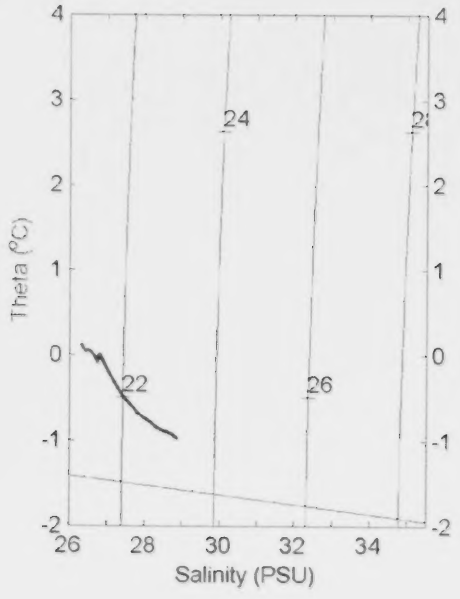
Cast 113 Station RG1



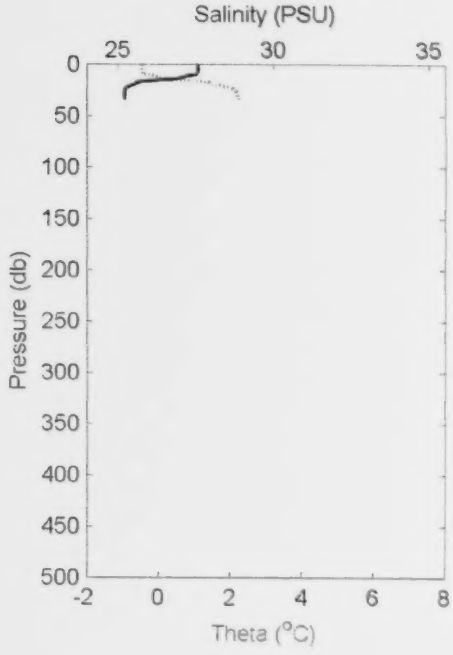


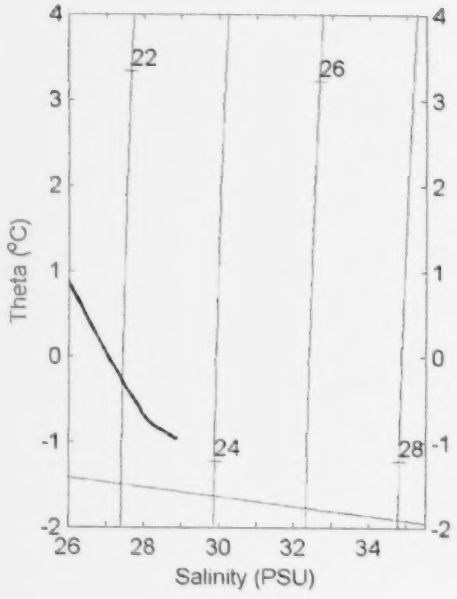
Cast 114 Station RG2



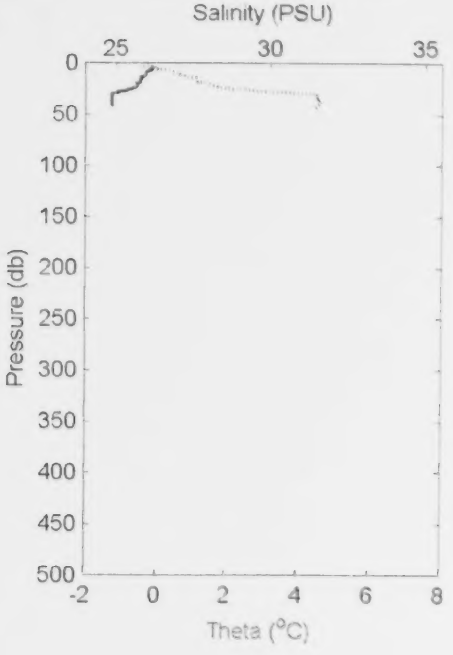


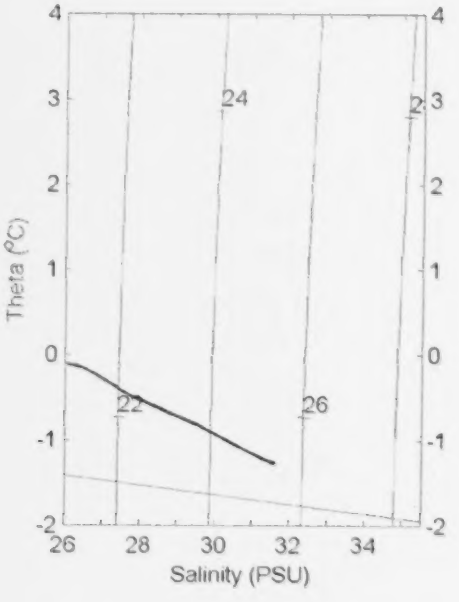
Cast 115 Station RG3





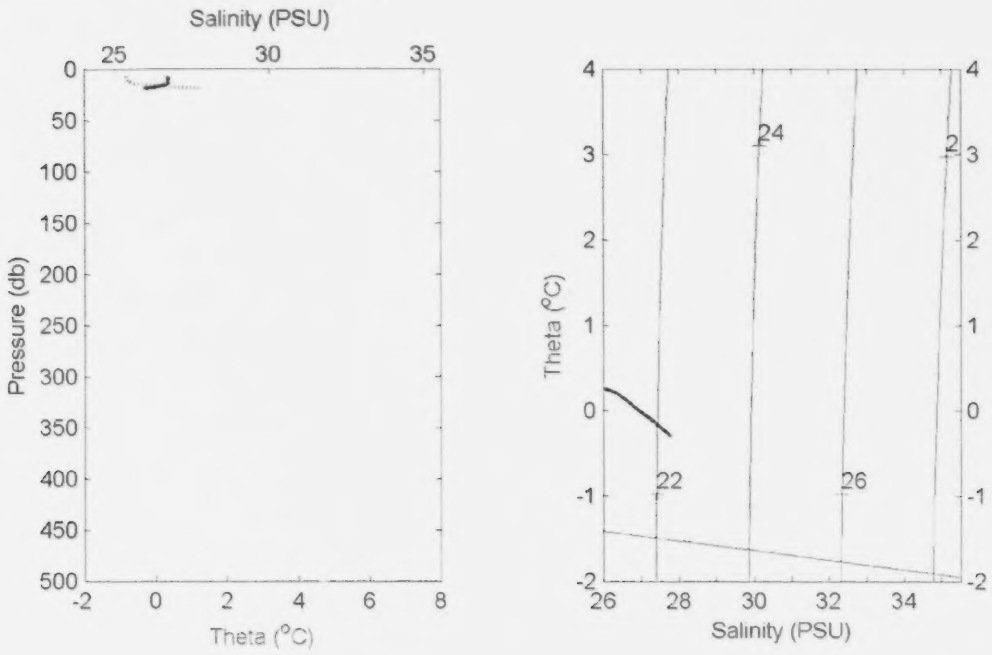
Cast 117 Station AI1



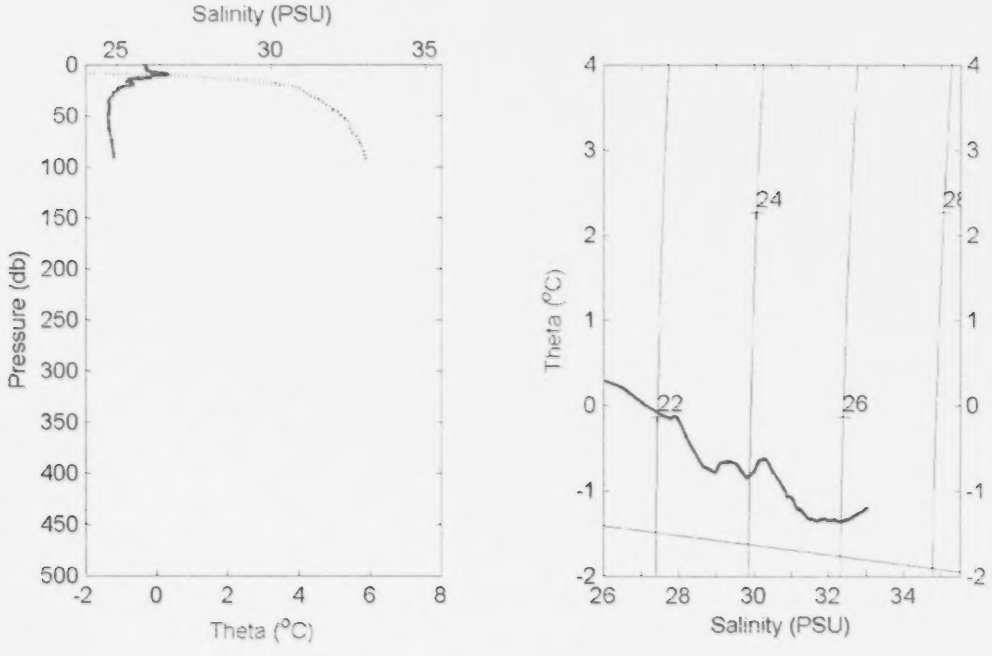


1999-24: CTD Casts

Cast 118 Station AI2

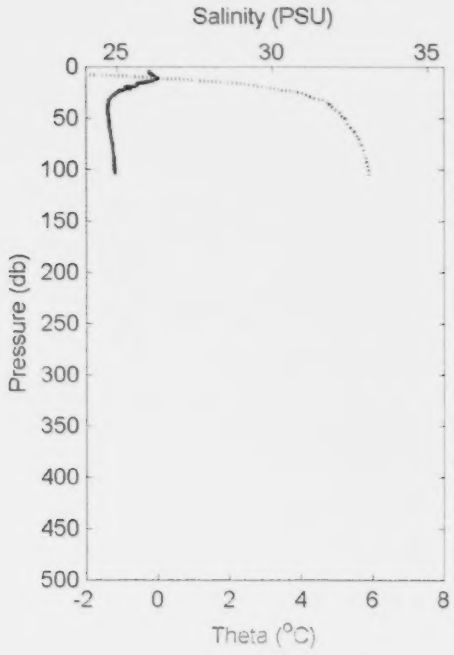


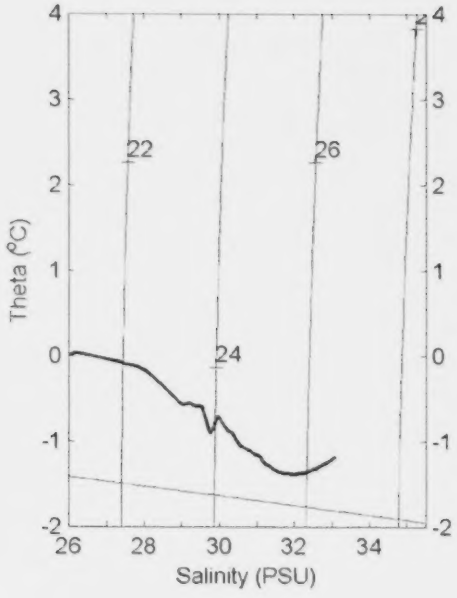
Cast 119 Station CF1



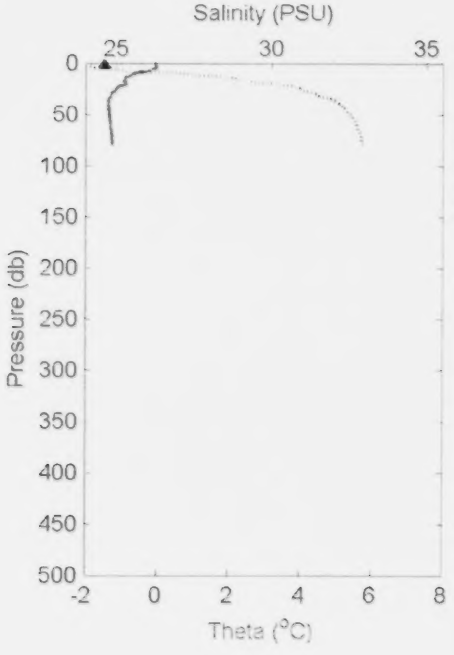
1999-24: CTD Casts

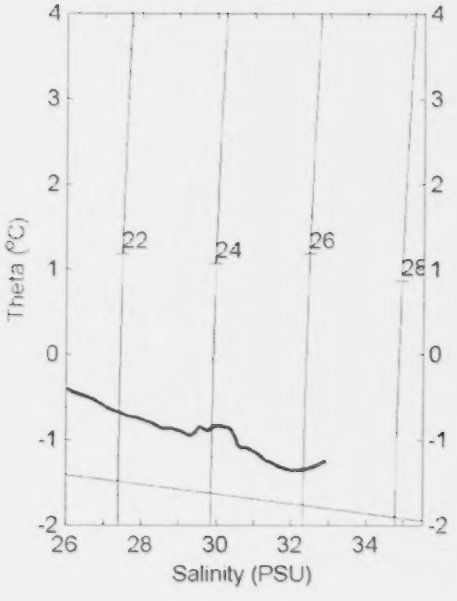
Cast 120 Station CF2





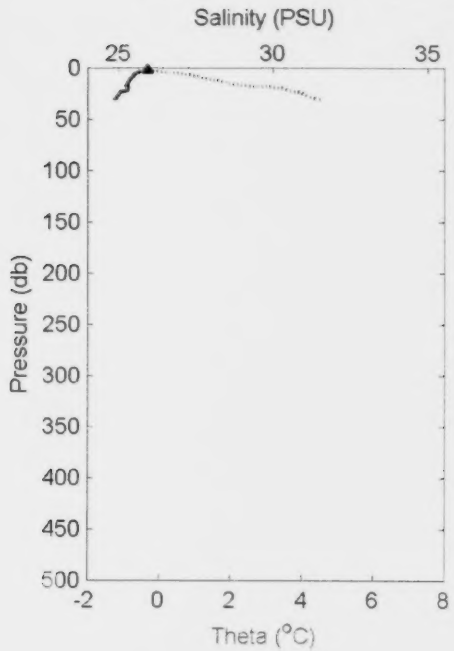
Cast 121 Station CF3

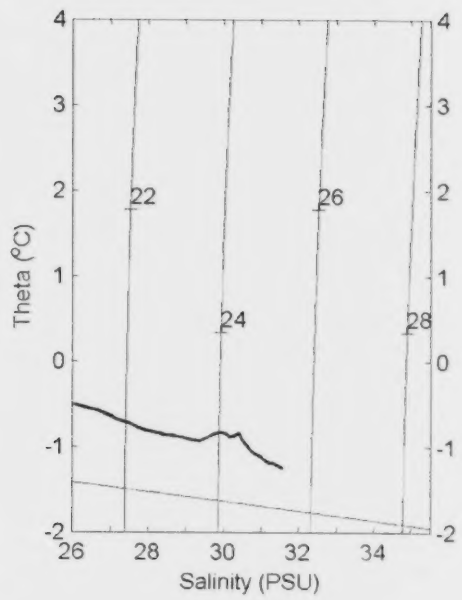




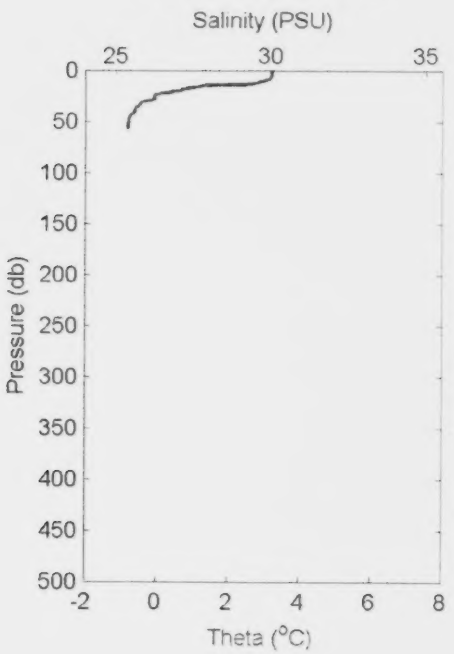
1999-24: CTD Casts

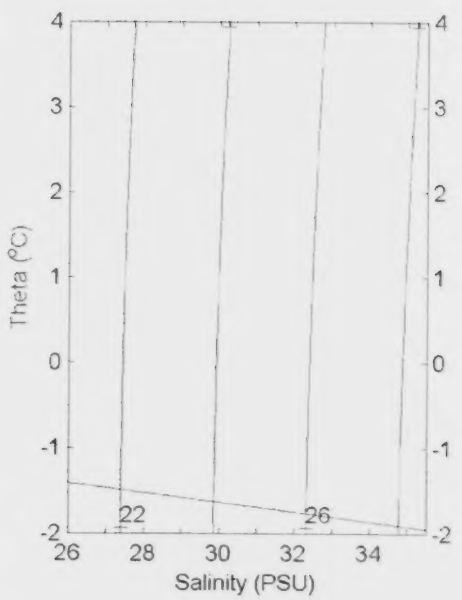
Cast 122 Station CF4





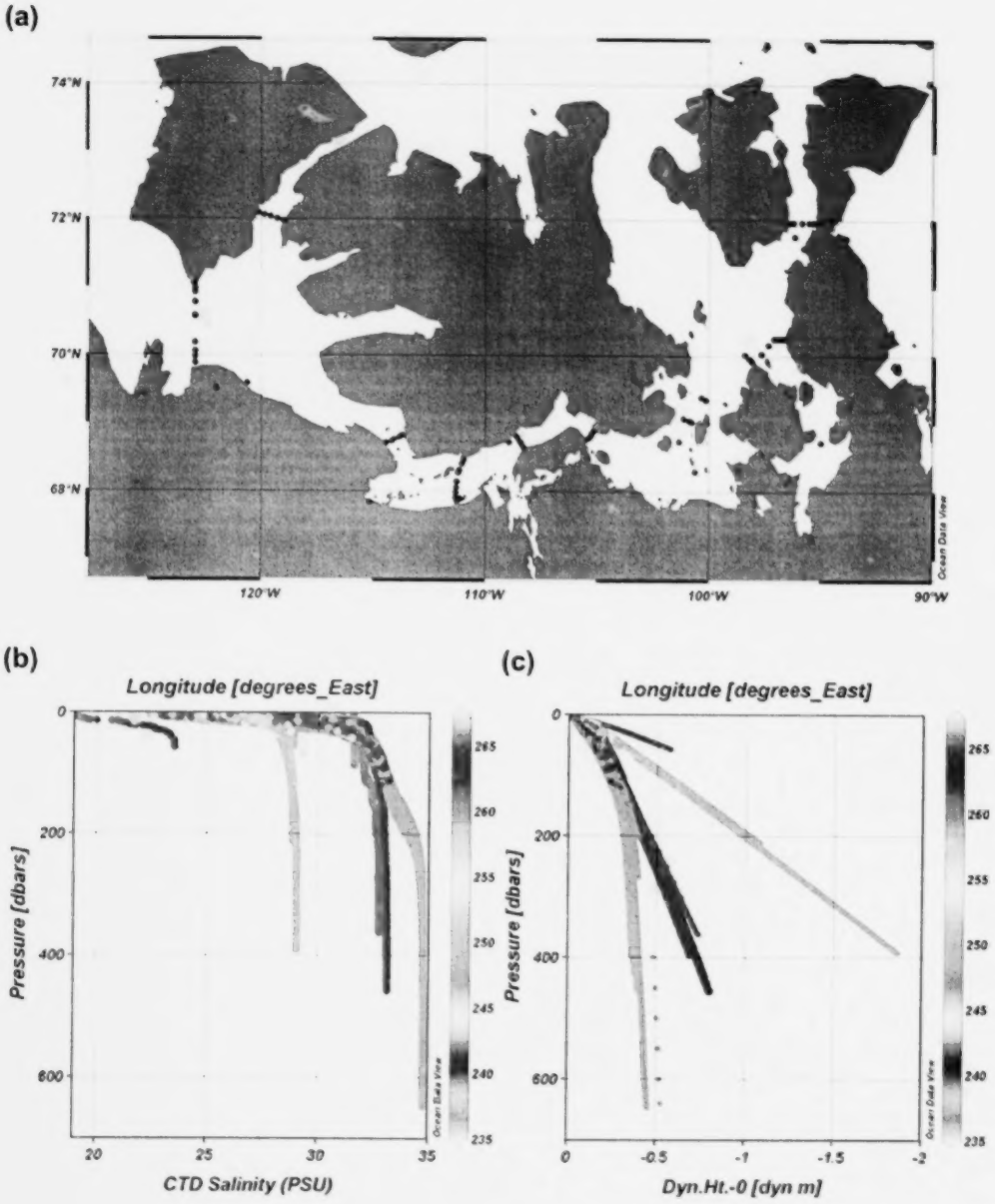
Cast 123 Station RS1



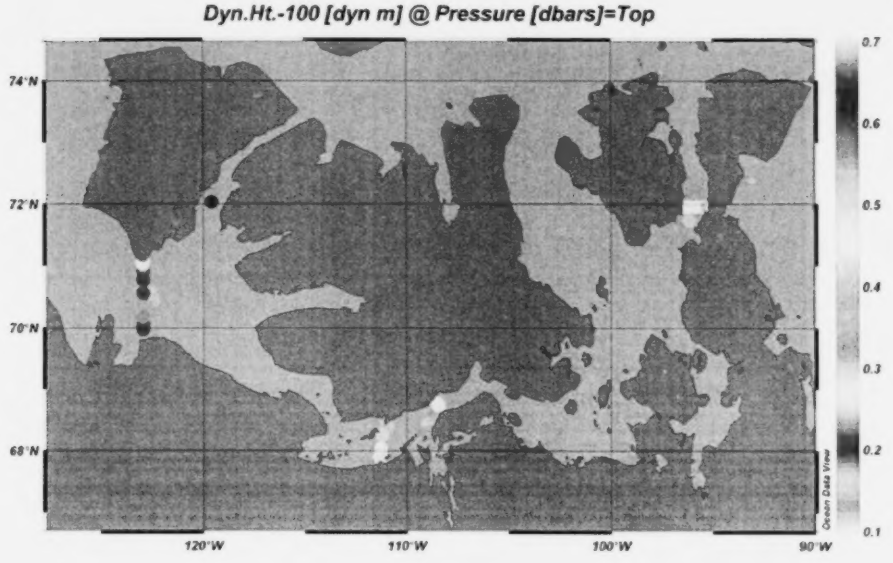


4.5 DYNAMIC HEIGHT AND SECTION PLOTS

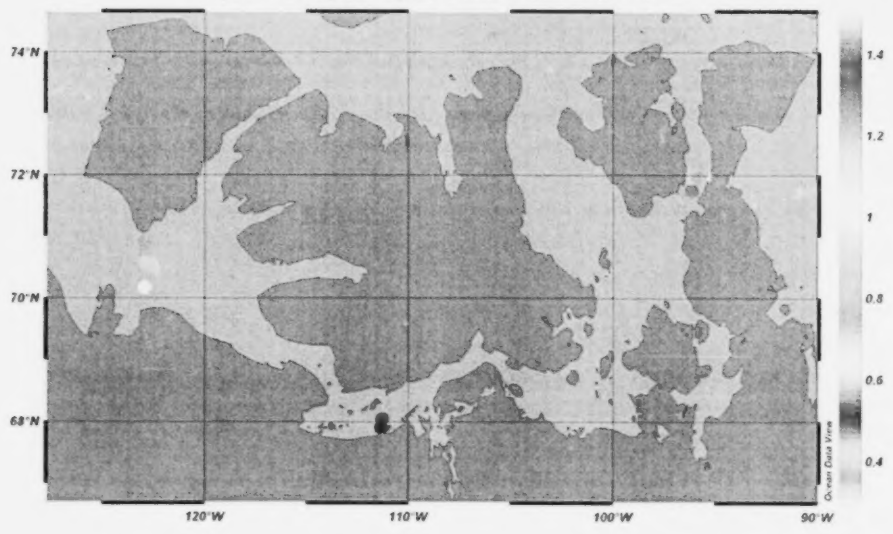
(a) Map showing location of all 1999-24 cruise stations in the Canadian Arctic Archipelago; (b) CTD salinity profiles and (c) dynamic height profiles, both coloured by longitude. Note: Longitude in (b) and (c) are reported in degrees East; in order to relate to longitude in (a), this value must be subtracted from 360 degrees.



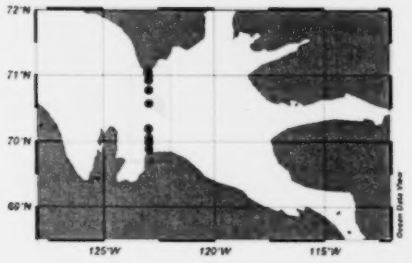
Dynamic height (m) at stations across the Canadian Arctic Archipelago calculated with respect to 100 m.

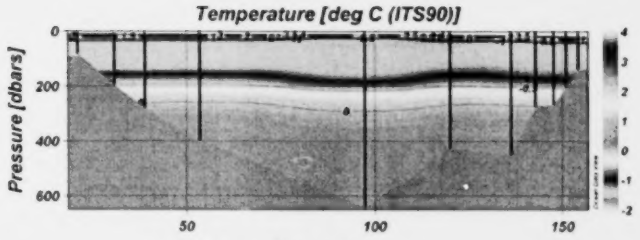


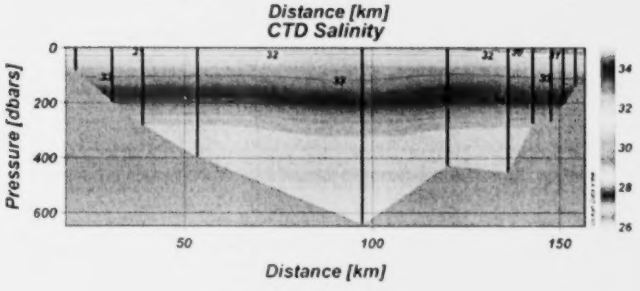
Dynamic height (m) in Amundsen Gulf, Coronation Gulf & Peel Sound calculated with 300 m as the depth of no motion.

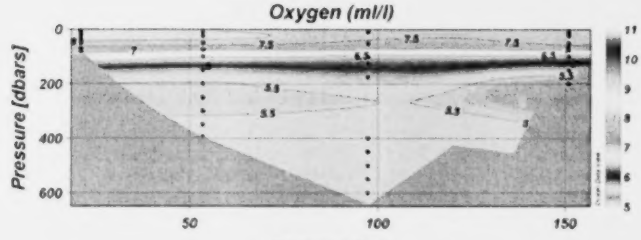


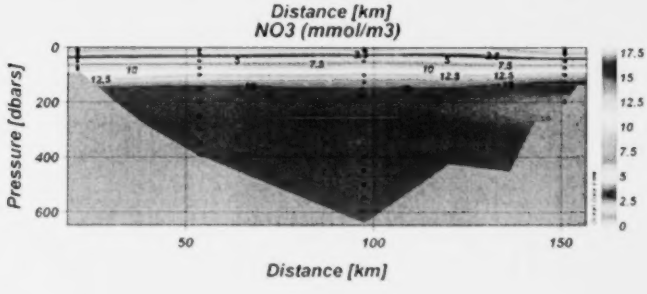
Amundsen Gulf Section:
Temperature; CTD Salinity; Oxygen; Nitrate



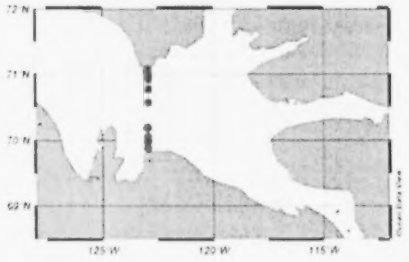


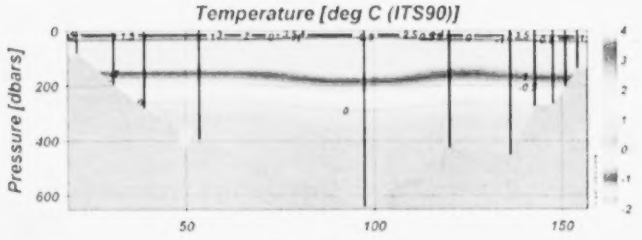


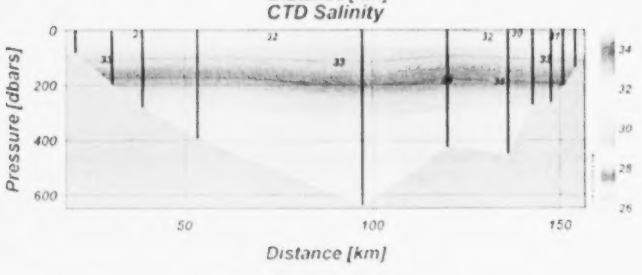


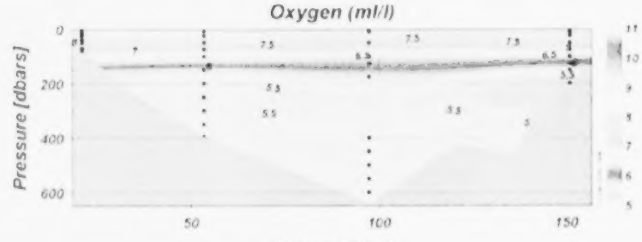


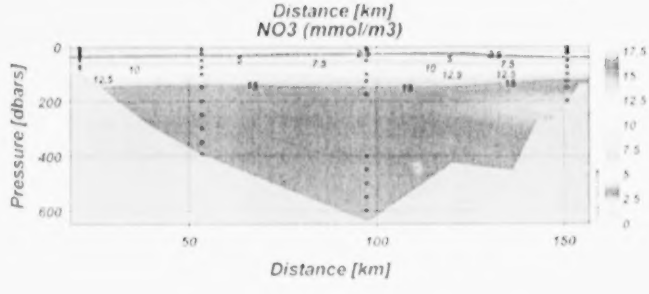
Amundsen Gulf Section:
Temperature; CTD Salinity; Oxygen; Nitrate



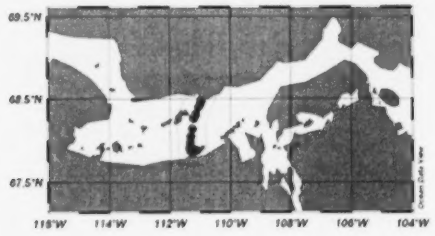


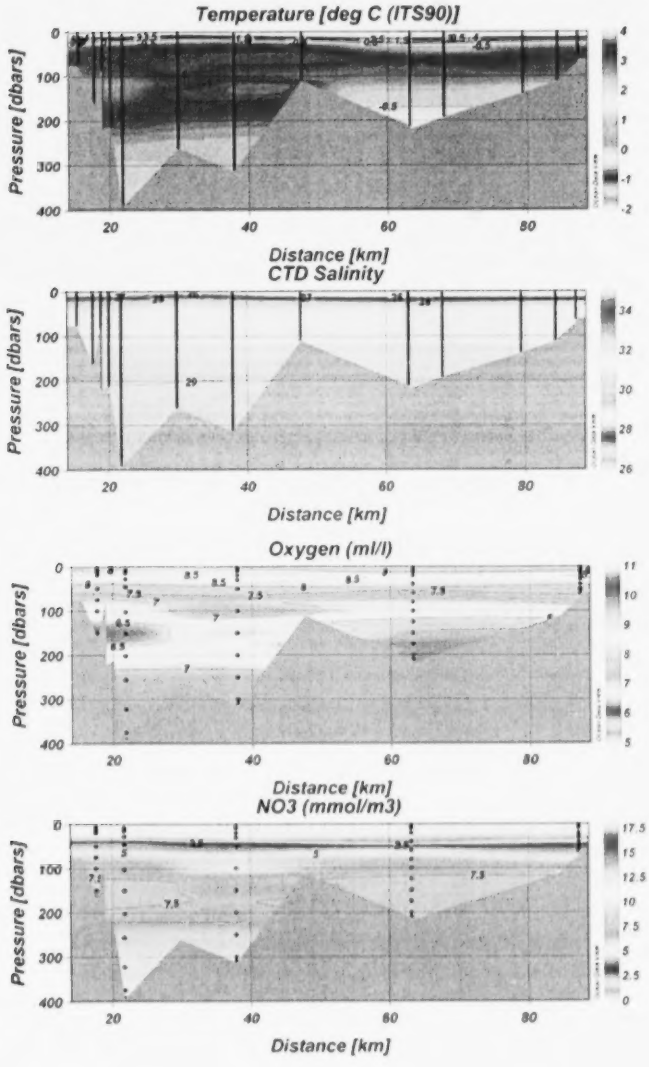




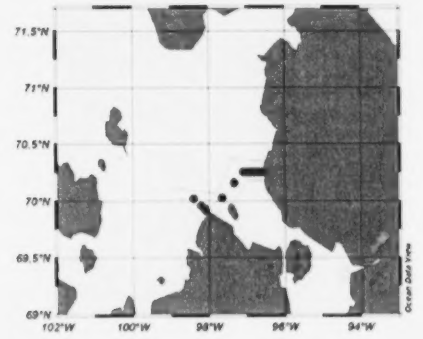


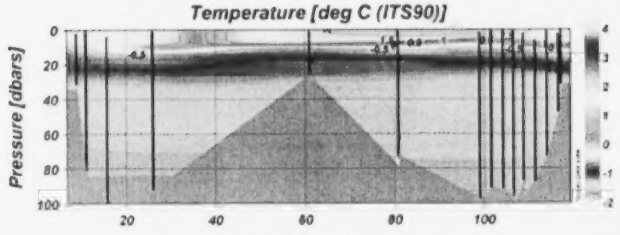
Coronation Gulf Section:
Temperature; CTD Salinity; Oxygen; Nitrate

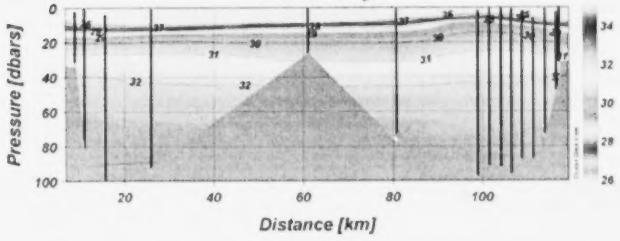


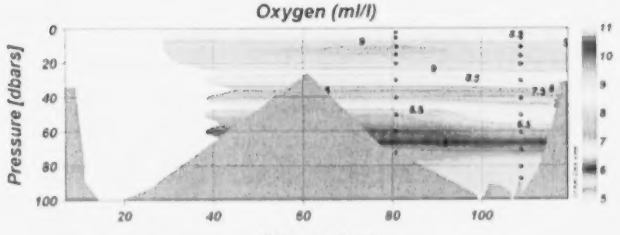


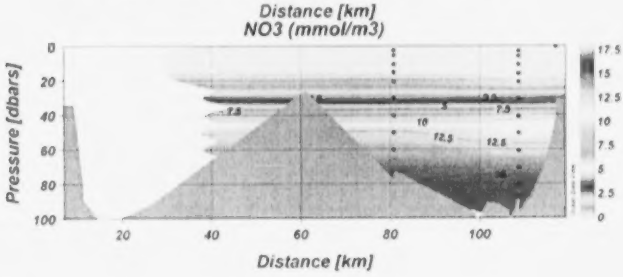
Larsen Sound and James Ross Strait Section: Temperature; CTD Salinity; Oxygen; Nitrate



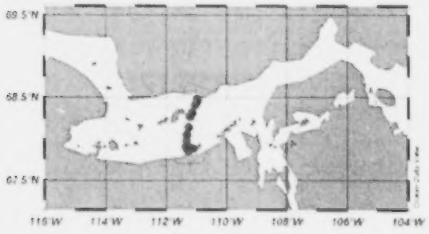


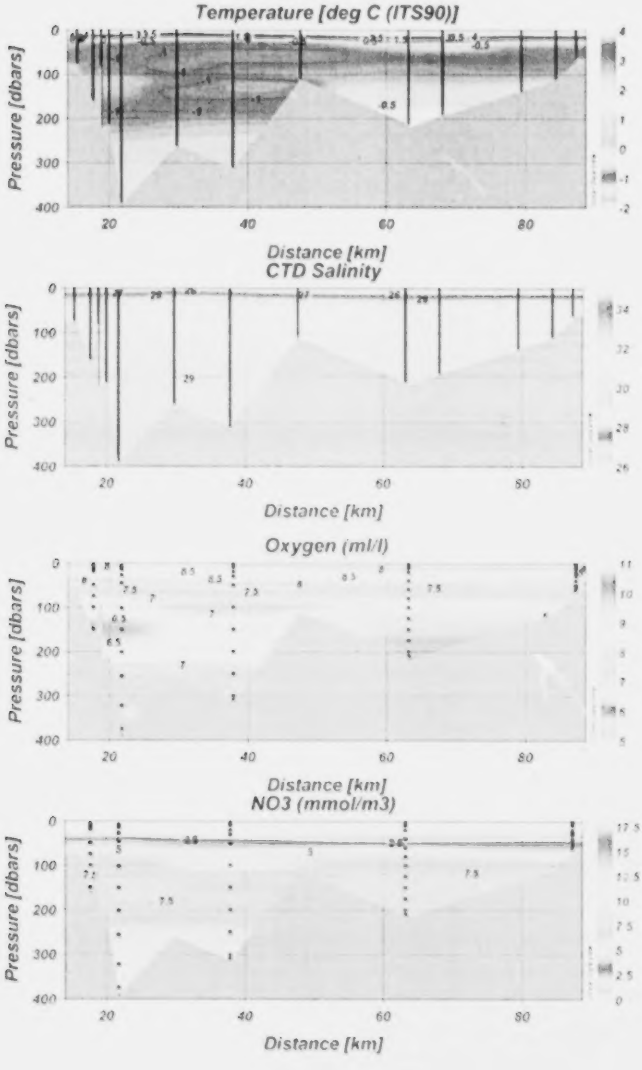




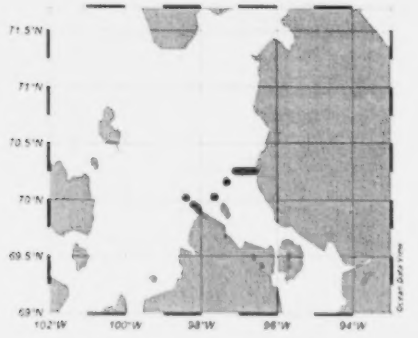


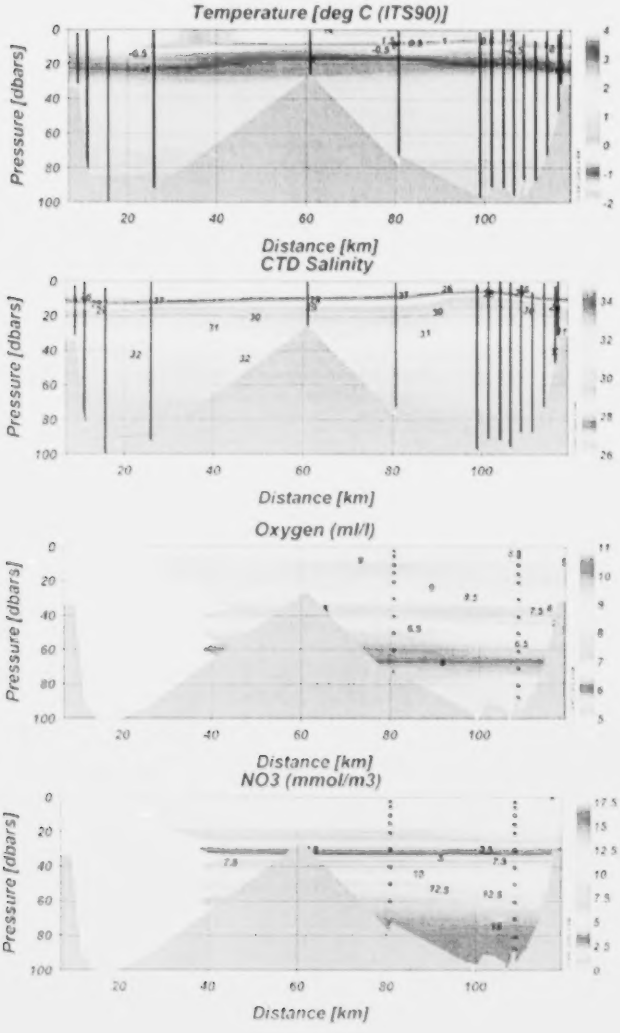
Coronation Gulf Section:
Temperature; CTD Salinity; Oxygen; Nitrate



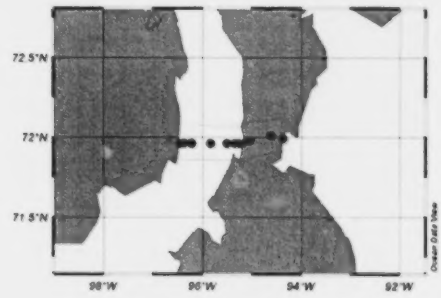


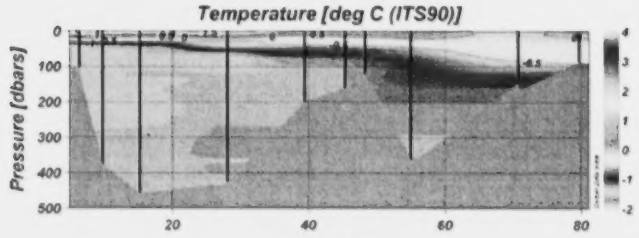
Larsen Sound and James Ross Strait Section: Temperature; CTD Salinity; Oxygen; Nitrate

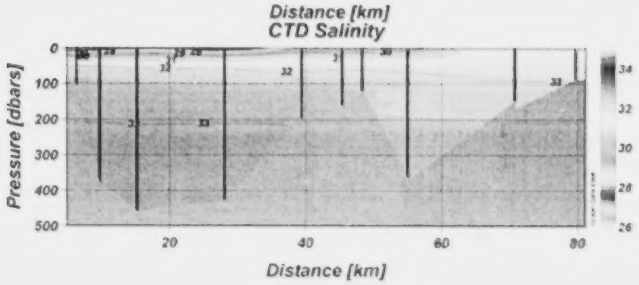


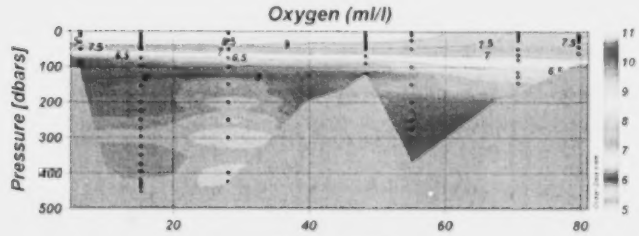


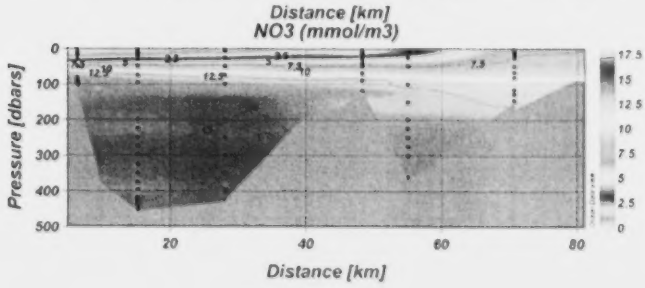
Peel Sound and Bellot Strait Section: Temperature; CTD Salinity; Oxygen; Nitrate



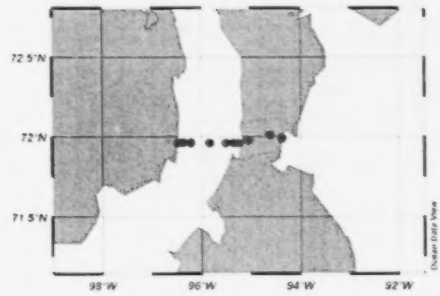


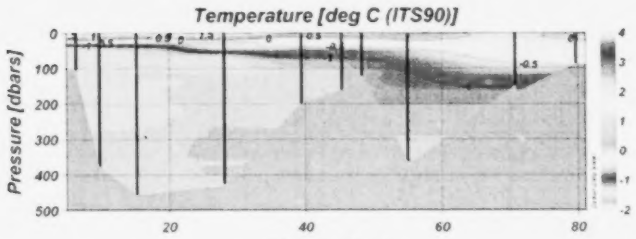


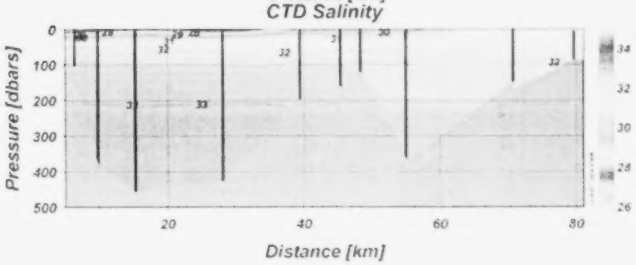


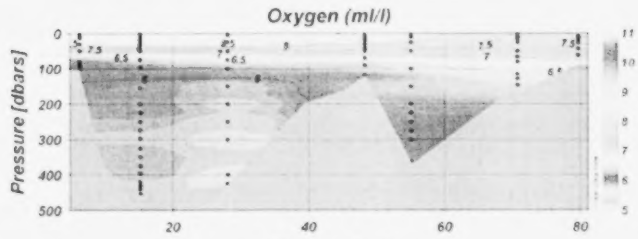


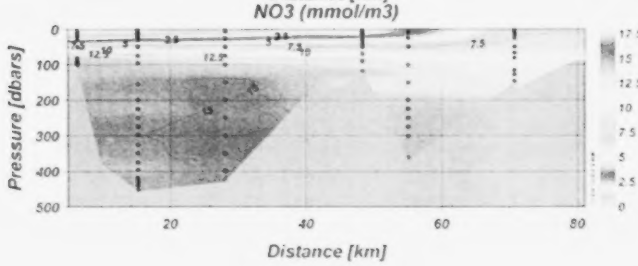
Peel Sound and Bellot Strait Section: Temperature; CTD Salinity; Oxygen; Nitrate











4.6 RIVER SAMPLES: NUTRIENTS, BARIUM AND OXYGEN ISOTOPE RATIO DATA.

Table 14. River sample data: nitrate + nitrite, silicate, phosphate, barium and oxygen isotope ratio.

Location	Discharges into:	Latitude (°N)	Longitude (°W)	Salinity (psu)	Sample Number	Sample Name	δO^{18}	Nitrate + Nitrite ($mmol/m^3$)	Silicate ($mmol/m^3$)	Phosphate ($mmol/m^3$)	Ba ($\mu mol/m^3$)
Hood R	Bathurst Inlet	67.00	108.82	0.0316		M01	-20.3	1.7	15.5	0.29	31.7
Hood R	Bathurst Inlet	67.00	108.82	0.0309		M02	-20.0	1.8	15.5	0.00	31.2
Hood R	Bathurst Inlet	67.00	108.82			M03	-20.2	1.8	15.5	0.00	30.5
Hood R	Bathurst Inlet	67.00	108.82			M04					31.1
Croker R	Dolphin and Union Strait	69.26	119.33	0.0905		M05	-20.0	1.8	14.9	0.12	95
Deas Thompson Pt R	Dolphin and Union Strait	69.75	121.5	0.2322		M06	-17.2	10.0	46.0	0.00	224.3
Back R	Chantry Inlet	67.26	95.32	1.6189				0.003	8.8	0.00	
Chantry Inlet	Back River/Chantry Inlet	67.67	95.69	12.2027	125	M07	-18.2				63.3
Chantry Inlet	Back River/Chantry Inlet	67.67	95.69	13.5254	126	M08	-18.2				54.6
Coppermine R	Coronation Gulf					M09	-19.0				85.2

4.7 ZOOPLANKTON TAXONOMY

Table 15. Zooplankton taxonomic analysis: abundance and biomass.

Order	Taxon	Length (mm)	Weight (mg)	FT3		AG5	
				#/m^3	mg/m^3	#/m^3	mg/m^3
Anim;Anne;Poly;Acic;Lopadorhynchidae	*Pelagobia longicirrata s1*	3.5	0.0350		0.000	0.37	0.013
Anim;Anne;Poly;Cana;Spionidae	Spionidae *sp. larvae s1	2.5	0.0800		0.000	0.37	0.029
Anim;Arth;Mala;Amph;Hyperiidae	*Themisto libellula s2*	6.0	0.9000		0.000	0.02	0.021
Anim;Arth;Mala;Euph;Euphausiidae	*Thysanoessa inermis M*	13.1	3.2900		0.000	0.02	0.075
Anim;Arth;Maxi;.	*Copepoda *sp. nauplii s1*	0.2	0.0003	38.01	0.011	4.75	0.001
Anim;Arth;Maxi;Cala;	*Calanoida *sp. 1*	0.5	0.0025	9.50	0.024		0.000
Anim;Arth;Maxi;Cala;	*Calanoida *sp. 2*	0.8	0.0075	21.72	0.163		0.000
Anim;Arth;Maxi;Cala;	*Calanoida *sp. 3*	1.2	0.0330	10.86	0.358		0.000
Anim;Arth;Maxi;Cala;Calanidae	*Calanus glacialis 5*	3.5	0.3200	46.16	14.770	14.25	4.558
Anim;Arth;Maxi;Cala;Calanidae	*Calanus glacialis 6F*	4.2	0.4740	2.21	1.046	1.19	0.563
Anim;Arth;Maxi;Cala;Calanidae	*Calanus hyperboreus 1*	0.9	0.0080	1.36	0.011		0.000
Anim;Arth;Maxi;Cala;Calanidae	*Calanus hyperboreus 3*	2.6	0.1650	2.72	0.448		0.000
Anim;Arth;Maxi;Cala;Calanidae	*Calanus hyperboreus 4*	4.1	0.6900	4.07	2.810		0.000
Anim;Arth;Maxi;Cala;Calanidae	*Calanus hyperboreus 5*	5.5	1.6200	10.69	17.318	4.34	7.027
Anim;Arth;Maxi;Cala;Calanidae	*Calanus hyperboreus 6F*	6.8	2.7300	4.75	12.971	0.23	0.623
Anim;Arth;Maxi;Cala;Clausocalanidae	*Microcalanus pusillus 5*	0.6	0.0020	2.72	0.005	4.75	0.009
Anim;Arth;Maxi;Cala;Clausocalanidae	*Microcalanus pusillus 6F*	0.7	0.0035		0.000	1.10	0.004
Anim;Arth;Maxi;Cala;Clausocalanidae	*Pseudocalanus *sp. 2*	0.3	0.0018	23.08	0.042		0.000
Anim;Arth;Maxi;Cala;Clausocalanidae	*Pseudocalanus *sp. 3*	0.5	0.0018	31.22	0.056		0.000
Anim;Arth;Maxi;Cala;Clausocalanidae	*Pseudocalanus *sp. 4*	0.7	0.0018	2.72	0.005		0.000
Anim;Arth;Maxi;Cala;Clausocalanidae	*Pseudocalanus major 4*	0.7	0.0018	1.36	0.002		0.000
Anim;Arth;Maxi;Cala;Clausocalanidae	*Pseudocalanus major 5M*	0.9	0.0060	1.36	0.008		0.000
Anim;Arth;Maxi;Cala;Clausocalanidae	*Pseudocalanus major 6F*	1.4	0.0210	4.07	0.086		0.000
Anim;Arth;Maxi;Cala;Clausocalanidae	***Pseudocalanus minutus 4***	0.7	0.0018	10.86	0.020		0.000
Anim;Arth;Maxi;Cala;Clausocalanidae	***Pseudocalanus minutus 5F***	0.9	0.0080	9.50	0.076	2.19	0.018
Anim;Arth;Maxi;Cala;Clausocalanidae	***Pseudocalanus minutus 5M***	0.9	0.0060	13.58	0.081	0.73	0.004
Anim;Arth;Maxi;Cala;Clausocalanidae	***Pseudocalanus minutus 6F***	1.4	0.0210	2.72	0.057	1.46	0.031
Anim;Arth;Maxi;Cala;Euchaetidae	***Euchaetidae *sp. 2***	1.2	0.0290	2.72	0.079	0.37	0.011
Anim;Arth;Maxi;Cala;Euchaetidae	***Euchaetidae *sp. 3***	1.7	0.0835		0.000	0.73	0.061
Anim;Arth;Maxi;Cala;Euchaetidae	***Paraeuchaeta glacialis 5***	5.8	0.9330		0.000	0.18	0.170
Anim;Arth;Maxi;Cala;Euchaetidae	***Paraeuchaeta glacialis 6F***	7.3	5.9560	0.17	1.011	0.09	0.544
Anim;Arth;Maxi;Cala;Metridinidae	*Metridia longa 4*	2.1	0.2000		0.000	2.92	0.584
Anim;Arth;Maxi;Cala;Metridinidae	*Metridia longa 5*	3.5	0.3340	14.93	4.987	26.66	8.906
Anim;Arth;Maxi;Cala;Metridinidae	*Metridia longa 6F*	4.5	0.5920	5.43	3.215	16.07	9.514
Anim;Arth;Maxi;Cala;Metridinidae	*Metridia longa 6M*	3.5	0.3340	1.36	0.453	0.37	0.122
Anim;Arth;Maxi;Cala;Scolecitrichidae	*Scolecithricella minor 5*	0.8	0.0050	1.36	0.007		0.000
Anim;Arth;Maxi;Cala;Scolecitrichidae	*Scolecithricella minor 6F*	1.1	0.0110		0.000	1.10	0.012
Anim;Arth;Maxi;Cycl;Oithonidae	*Oithona similis 5*	0.6	0.0005	48.87	0.024	13.15	0.007
Anim;Arth;Maxi;Cycl;Oithonidae	*Oithona similis 6F*	0.9	0.0015	96.38	0.145	31.05	0.047
Anim;Arth;Maxi;Poec;Oncaeidae	*Oncaea borealis 6F*	0.7	0.0003	16.29	0.005	17.17	0.005
Anim;Arth;Maxi;Poec;Oncaeidae	*Oncaea borealis 6M*	0.4	0.0001	5.43	0.001	3.29	0.000
Anim;Chae;Sagi;Aphr;Sagittidae	*Parasagitta elegans s2*	7.5	0.0880	0.17	0.015		0.000
Anim;Chae;Sagi;Aphr;Sagittidae	*Parasagitta elegans s3*	20.0	1.0500	1.36	1.425	0.32	0.336
Anim;Chae;Sagi;Phra;Eukrohniidae	*Eukrohnia hamata s3*	18.0	1.4000		0.000	0.55	0.767
Anim;Chor;Appe;Cope;Fritillariidae	*Fritillaria borealis s1*	1.0	0.0100	4.07	0.041		0.000
Anim;Chor;Appe;Cope;Oikopleuridae	*Oikopleura *sp. s2*	6.0	0.2160	0.17	0.037		0.000
Anim;Cnid;Hydr;Siph;Diphyidae	*Dimophyes arctica nectophores s2*	7.5	0.5900		0.000	0.27	0.162
Anim;Cnid;Hydr;Siph;Diphyidae	*Diphyes *sp. nectophores s1*	3.5	0.0686		0.000	0.37	0.025
Anim;Cnid;Hydr;Trac;Aeginidae	*Aegina *sp. s2*	7.5	3.5000	0.17	0.594		0.000
Anim;Cnid;Hydr;Trac;Rhopalonematidae	*Aglantha digitalis s2*	7.5	1.9000	0.17	0.322	2.33	1.424
Anim;Cnid;Hydr;Trac;Rhopalonematidae	*Aglantha digitalis s3*	13.2	3.2200		0.000	0.37	1.176
Anim;Cten;Nuda;Bero;Beroidae	*Beroe *sp. s2*	7.5	1.7000	0.17	0.288		0.000
Anim;Cten;Nuda;Bero;Beroidae	*Beroe *sp. s3*	22.0	3.5000		0.000	0.02	0.080
Anim;Moll;Gast;Gymn;Clionidae	*Clione limacina s3*	12.0	7.6000	0.34	2.579		0.000
Anim;Moll;Gast;Thec;Limacinidae	*Limacina helicina s0*	1.0	0.0850	5.43	0.462	2.56	0.217
Anim;Moll;Gast;Thec;Limacinidae	*Limacina helicina s2*	6.0	1.8300	0.51	0.932		0.000
	TOTALS				**67.0**		**40.1**

4.7 ZOOPLANKTON TAXONOMY

Table 15. Zooplankton taxonomic analysis: abundance and biomass.

Order	Taxon	Length (mm)	Weight (mg)	FT3		AG5	
				#/m^3	mg/m^3	#/m^3	mg/m^3
Anim:Anne:Poly:Acic:Lopadorhynchidae	*Pelagobia longicirrata s1*	3.5	0.0350		0.000	0.37	0.013
Anim:Anne:Poly:Cana:Spionidae	Spionidae *sp. larvae s1	2.5	0.0800		0.000	0.37	0.029
Anim:Arth:Mala:Amph:Hyperiidae	*Themisto libellula s2*	6.0	0.9000		0.000	0.02	0.021
Anim:Arth:Mala:Euph:Euphausiidae	*Thysanoessa inermis M*	13.1	3.2900		0.000	0.02	0.075
Anim:Arth:Maxi::	*Copepoda *sp. nauplii s1*	0.2	0.0003	38.01	0.011	4.75	0.001
Anim:Arth:Maxi:Cala:	*Calanoida *sp. 1*	0.5	0.0025	9.50	0.024		0.000
Anim:Arth:Maxi:Cala:	*Calanoida *sp. 2*	0.8	0.0075	21.72	0.163		0.000
Anim:Arth:Maxi:Cala:	*Calanoida *sp. 3*	1.2	0.0330	10.86	0.358		0.000
Anim:Arth:Maxi:Cala:Calanidae	*Calanus glacialis 5*	3.5	0.3200	46.16	14.770	14.25	4.558
Anim:Arth:Maxi:Cala:Calanidae	*Calanus glacialis 6F*	4.2	0.4740	2.21	1.046	1.19	0.563
Anim:Arth:Maxi:Cala:Calanidae	*Calanus hyperboreus 1*	0.9	0.0080	1.36	0.011		0.000
Anim:Arth:Maxi:Cala:Calanidae	*Calanus hyperboreus 3*	2.6	0.1650	2.72	0.448		0.000
Anim:Arth:Maxi:Cala:Calanidae	*Calanus hyperboreus 4*	4.1	0.6900	4.07	2.810		0.000
Anim:Arth:Maxi:Cala:Calanidae	*Calanus hyperboreus 5*	5.5	1.6200	10.69	17.318	4.34	7.027
Anim:Arth:Maxi:Cala:Calanidae	*Calanus hyperboreus 6F*	6.8	2.7300	4.75	12.971	0.23	0.623
Anim:Arth:Maxi:Cala:Clausocalanidae	*Microcalanus pusillus 5*	0.6	0.0020	2.72	0.005	4.75	0.009
Anim:Arth:Maxi:Cala:Clausocalanidae	*Microcalanus pusillus 6F*	0.7	0.0035		0.000	1.10	0.004
Anim:Arth:Maxi:Cala:Clausocalanidae	*Pseudocalanus *sp. 2*	0.3	0.0018	23.08	0.042		0.000
Anim:Arth:Maxi:Cala:Clausocalanidae	*Pseudocalanus *sp. 3*	0.5	0.0018	31.22	0.056		0.000
Anim:Arth:Maxi:Cala:Clausocalanidae	*Pseudocalanus *sp. 4*	0.7	0.0018	2.72	0.005		0.000
Anim:Arth:Maxi:Cala:Clausocalanidae	*Pseudocalanus major 4*	0.7	0.0018	1.36	0.002		0.000
Anim:Arth:Maxi:Cala:Clausocalanidae	*Pseudocalanus major 5M*	0.9	0.0060	1.36	0.008		0.000
Anim:Arth:Maxi:Cala:Clausocalanidae	*Pseudocalanus major 6F*	1.4	0.0210	4.07	0.086		0.000
Anim:Arth:Maxi:Cala:Clausocalanidae	*Pseudocalanus minutus 4*	0.7	0.0018	10.86	0.020		0.000
Anim:Arth:Maxi:Cala:Clausocalanidae	*Pseudocalanus minutus 5F*	0.9	0.0080	9.50	0.076	2.19	0.018
Anim:Arth:Maxi:Cala:Clausocalanidae	*Pseudocalanus minutus 5M*	0.9	0.0060	13.58	0.081	0.73	0.004
Anim:Arth:Maxi:Cala:Clausocalanidae	*Pseudocalanus minutus 6F*	1.4	0.0210	2.72	0.057	1.46	0.031
Anim:Arth:Maxi:Cala:Euchaetidae	*Euchaetidae *sp. 2*	1.2	0.0290	2.72	0.079	0.37	0.011
Anim:Arth:Maxi:Cala:Euchaetidae	*Euchaetidae *sp. 3*	1.7	0.0835		0.000	0.73	0.061
Anim:Arth:Maxi:Cala:Euchaetidae	*Paraeuchaeta glacialis 5*	5.8	0.9330		0.000	0.18	0.170
Anim:Arth:Maxi:Cala:Euchaetidae	*Paraeuchaeta glacialis 6F*	7.3	5.9560	0.17	1.011	0.09	0.544
Anim:Arth:Maxi:Cala:Metridinidae	*Metridia longa 4*	2.1	0.2000		0.000	2.92	0.584
Anim:Arth:Maxi:Cala:Metridinidae	*Metridia longa 5*	3.5	0.3340	14.93	4.987	26.66	8.906
Anim:Arth:Maxi:Cala:Metridinidae	*Metridia longa 6F*	4.5	0.5920	5.43	3.215	16.07	9.514
Anim:Arth:Maxi:Cala:Metridinidae	*Metridia longa 6M*	3.5	0.3340	1.36	0.453	0.37	0.122
Anim:Arth:Maxi:Cala:Scolecitrichidae	*Scolecithricella minor 5*	0.8	0.0050	1.36	0.007		0.000
Anim:Arth:Maxi:Cala:Scolecitrichidae	*Scolecithricella minor 6F*	1.1	0.0110		0.000	1.10	0.012
Anim:Arth:Maxi:Cycl:Oithonidae	*Oithona similis 5*	0.6	0.0005	48.87	0.024	13.15	0.007
Anim:Arth:Maxi:Cycl:Oithonidae	*Oithona similis 6F*	0.9	0.0015	96.38	0.145	31.05	0.047
Anim:Arth:Maxi:Poec:Oncaeidae	*Oncaea borealis 6F*	0.7	0.0003	16.29	0.005	17.17	0.005
Anim:Arth:Maxi:Poec:Oncaeidae	*Oncaea borealis 6M*	0.4	0.0001	5.43	0.001	3.29	0.000
Anim:Chae:Sagi:Aphr:Sagittidae	*Parasagitta elegans s2*	7.5	0.0880	0.17	0.015		0.000
Anim:Chae:Sagi:Aphr:Sagittidae	*Parasagitta elegans s3*	20.0	1.0500	1.36	1.425	0.32	0.336
Anim:Chae:Sagi:Phra:Eukrohniidae	*Eukrohnia hamata s3*	18.0	1.4000		0.000	0.55	0.767
Anim:Chor:Appe:Cope:Fritillaridae	*Fritillaria borealis s1*	1.0	0.0100	4.07	0.041		0.000
Anim:Chor:Appe:Cope:Oikopleuridae	*Oikopleura *sp. s2*	6.0	0.2160	0.17	0.037		0.000
Anim:Cnid:Hydr:Siph:Diphyidae	*Dimophyes arctica nectophores s2*	7.5	0.5900		0.000	0.27	0.162
Anim:Cnid:Hydr:Siph:Diphyidae	*Diphyes *sp. nectophores s1*	3.5	0.0686		0.000	0.37	0.025
Anim:Cnid:Hydr:Trac:Aeginidae	*Aegina *sp. s2*	7.5	3.5000	0.17	0.594		0.000
Anim:Cnid:Hydr:Trac:Rhopalonematidae	*Aglantha digitalis s2*	7.5	1.9000	0.17	0.322	2.33	4.424
Anim:Cnid:Hydr:Trac:Rhopalonematidae	*Aglantha digitalis s3*	13.2	3.2200		0.000	0.37	1.176
Anim:Cten:Nuda:Bero:Beroidae	*Beroe *sp. s2*	7.5	1.7000	0.17	0.288		0.000
Anim:Cten:Nuda:Bero:Beroidae	*Beroe *sp. s3*	22.0	3.5000		0.000	0.02	0.080
Anim:Moll:Gast:Gymn:Clionidae	*Clione limacina s3*	12.0	7.6000	0.34	2.579		0.000
Anim:Moll:Gast:Thec:Limacinidae	*Limacina helicina s0*	1.0	0.0850	5.43	0.462	2.56	0.217
Anim:Moll:Gast:Thec:Limacinidae	*Limacina helicina s2*	6.0	1.8300	0.51	0.932		0.000
	TOTALS				**67.0**		**40.1**

Table 16. Zooplankton taxonomic analysis summary: biomass.

Taxon	Biomass (mg/m^3)	
	FT3	AG5
Pelagobia longicirrata s1		0.013
Spionidae *sp. larvae s1		0.029
Themisto libellula s2		0.021
Thysanoessa inermis M		0.075
*Copepoda *sp. nauplii s1*	0.011	0.001
*Calanoida *sp.*	0.545	
Calanus glacialis spp.	15.815	5.121
Calanus hyperboreus spp.	33.558	7.650
Microcalanus pusillus spp.	0.005	0.013
*Pseudocalanus *sp.*	0.103	
Pseudocalanus major spp.	0.096	
Pseudocalanus minutus spp.	0.234	0.053
Euchaetidae *sp.	1.089	0.786
Metridia longa spp.	8.655	19.127
Scolecithricella minor spp.	0.007	0.012
Oithona similis spp.	0.169	0.053
Oncaea borealis spp.	0.005	0.005
Chaetognath *sp.	1.440	1.103
Copelata *sp.	0.077	
Siphonophorae *sp.		0.187
Hydromedusae *sp.	0.916	5.600
*Beroe *sp.*	0.288	0.080
Clione limacina s3	2.579	
Limacina helicina spp.	1.393	0.217
TOTAL	***67.0***	***40.1***

4.8 SEDIMENT

Table 17. Mission 1999-24 sediment core sample C/N ratios.

Station	Sample ID	Core Depth (cm)	Dry Sample Weight (g)	Moisture Content	Sample Weight Salt Corrected (g)	Organic Carbon Salt Corrected (% ug/ug)	Organic Nitrogen Salt Corrected (% ug/ug)	C/N Ratio
7a	1	0-1	0.47781	0.3811	0.4678	0.484	0.092	5.24
	2	1-2	0.46564	0.3555	0.4569	0.387	0.083	4.67
	3	2-3	0.50378	0.3355	0.4951	0.312	0.071	4.42
	4	3-4	0.50761	0.2741	0.5011	0.230	0.062	3.70
	5	4-5	0.50568	0.2259	0.5006	0.178	0.045	3.98
	6	5-6	0.59628	0.2109	0.5908	0.166	0.043	3.90
	7	6-7	0.56379	0.1959	0.5591	0.139	0.037	3.70
	8	7-8	0.43896	0.1866	0.4355			
	9	8-9	0.64974	0.1835	0.6448	0.128	0.039	3.32
	10	8-9	0.42718	0.1787	0.4240	0.119	0.042	2.81
	11	9-10	0.56118	0.1813	0.5569	0.138	0.040	3.40
	12	10-12	0.61913	0.1838	0.6144	0.118	0.034	3.44
	13	12-14	0.52653	0.1740	0.5227	0.115	0.039	2.92
	14	12-14	0.47239	0.1734	0.4690	0.177	0.040	4.38
	15	14-16	0.53952	0.1720	0.5357	0.166	0.038	4.32
	16	16-18	0.49337	0.1754	0.4898	0.189	0.038	4.92
	17	18-19.5	0.52924	0.1638	0.5257	0.143	0.033	4.27
6c	18	0-1	0.51226	0.4459	0.4982	0.553	0.111	4.96
	19	1-2	0.59215	0.4610	0.5749	0.550	0.121	4.55
	20	2-3	0.48106	0.4630	0.4669	0.558	0.128	4.35
	21	3-4	0.446	0.4568	0.4332	0.545	0.126	4.32
	22	4-5	0.51318	0.4486	0.4989	0.548	0.126	4.34
	23	5-6	0.44079	0.4316	0.4294	0.560	0.123	4.57
	24	6-7	0.5607	0.4155	0.5471	0.527	0.117	4.49
	25	7-8	0.46782	0.4077	0.4568	0.475	0.114	4.16
	26	7-8	0.47431	0.4062	0.4632	0.440	0.108	4.08
	27	8-9	0.43844	0.3881	0.428949	0.414	0.104	4.00
	28	9-10	0.5133	0.3812	0.502509	0.404	0.098	4.10
	29	10-12	0.4439	0.3540	0.435599	0.359	0.090	3.99
	30	12-14	0.52582	0.2756	0.518992	0.207	0.068	3.06
	31	14-16	0.5457	0.2537	0.539368	0.182	0.063	2.89
	32	16-18	0.45907	0.2080	0.454957	0.110	0.445	0.25
	33	18-20	0.62637	0.1734	0.621886	0.097	2.999	0.03
	34	18-20	0.45718	0.1598	0.454212	0.106	0.097	1.09
	35	20-25	0.532436	0.1845	0.528325	0.051	0.056	0.91
	36	20-25	0.47906	0.2083	0.474759	0.047	0.060	0.78
BCSS1 Marine Ref		37	0.51471		0.57509	1.761	0.191	9.22
		38	0.49979		0.55944	1.815	0.192	9.45

(Cont'd) Mission 1999-24 sediment core sample C/N ratios.

Station	Sample ID	Core Depth (cm)	Dry Sample Weight (g)	Moisture Content	Sample Weight Salt Corrected (g)	Organic Carbon Salt Corrected (% ug/ug)	Organic Nitrogen Salt Corrected (% ug/ug)	C/N Ratio
AG-5	1	0-1	0.45558	0.5740	0.4346	1.258	0.202	6.24
	2	1-2	0.46656	0.5638	0.4460	1.217	0.201	6.06
	3	2-3	0.49326	0.5565	0.4721	1.102	0.178	6.20
	4	3-4	0.49997	0.5383	0.4801	1.070	0.166	6.45
	5	4-5	0.48077	0.5290	0.4623	1.077	0.167	6.45
	6	5-6	0.51971	0.5201	0.5005	1.052	0.160	6.59
	7	6-7	0.45991	0.5022	0.4441	1.052	0.164	6.41
	9	7-8	0.47276	0.4957	0.4569	0.958	0.158	6.06
	10	8-9	0.42356	0.4864	0.4099	0.897	0.152	5.90
	11	9-10	0.50038	0.4766	0.4848	0.783	0.132	5.95
	12	10-11	0.47350	0.4759	0.4588	0.653	0.121	5.39
	13	12-14	0.44600	0.4421	0.4339	0.663	0.117	5.67
	14	14-16	0.52349	0.4255	0.5103	0.605	0.115	5.25
	16	16-18	0.48596	0.4219	0.4739	0.608	0.123	4.93
	17	18-20	0.56383	0.4256	0.5496	0.622	0.116	5.39
	18	20-25	0.46639	0.4197	0.4549	0.549	0.115	4.78
	19	25-30	0.48820	0.2843	0.4816	0.470	0.098	4.78
	20	30-35	0.55241	0.2821	0.5450	0.221	0.080	2.78
	22	35-39	0.45929	0.2121	0.4551	0.329	0.327	1.00
duplicates								
	8	7-8	0.48152	0.4851	0.4660	0.956	0.155	6.19
	15	16-18	0.48197	0.4220	0.4700	0.608	0.124	4.92
	21	35-39	0.48302	0.3708	0.4733	0.362	0.298	1.22
FT-3	1	0-1	0.54502	0.3988	0.5327	0.469	0.318	1.48
	2	1-2	0.42221	0.3947	0.4128	0.466	0.160	2.91
	3	2-3	0.48894	0.3928	0.4781	0.434	0.129	3.36
*low	4	3-4	0.49347	0.3868	0.4828	0.437	0.652	0.67
	5	4-5	0.52658	0.3684	0.5161	0.428	0.134	3.19
	6	5-6	0.50189	0.3472	0.4928	0.392	0.130	3.01
	8	6-7	0.51176	0.3448	0.5026	0.404	0.120	3.36
	9	7-8	0.46061	0.3634	0.4516	0.370	0.139	2.67
	10	8-9	0.45770	0.3726	0.4484	0.385	0.204	1.89
	11	9-10	0.49401	0.3726	0.4840	0.378	0.134	2.81
	12	10-12	0.51903	0.3725	0.5085	0.384	0.138	2.79
	13	12-14	0.49780	0.3607	0.4882	0.380	0.131	2.89
	14	14-16	0.54569	0.3563	0.5354	0.384	0.135	2.84
	16	16-18	0.47290	0.3264	0.4651	0.381	0.129	2.95
	17	18-20	0.53330	0.3707	0.5226	0.381	0.281	1.36
	18	20-25	0.55945	0.3628	0.5486	0.350	0.646	0.54
*low	19	25-30	0.52801	0.3455	0.5185	0.355	0.995	0.36
	21	30-35	0.96363	0.3072	0.9490	0.210	0.079	2.65
duplicates								
	7	6-7	0.49836	0.3614	0.4908	0.414	0.118	3.51

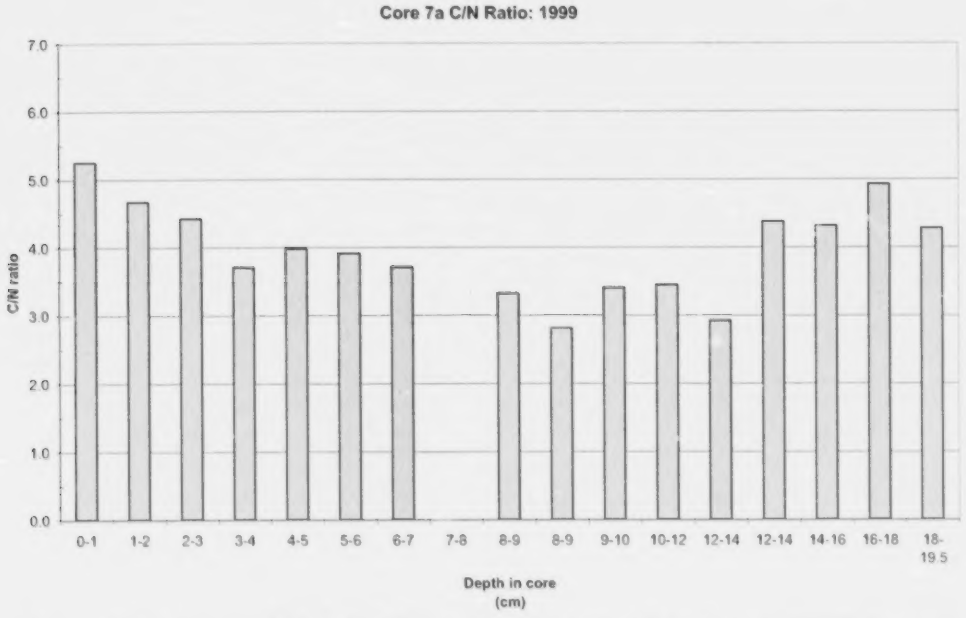


Figure 16. Viscount Melville Sound sediment: C/N ratio vs depth in core.

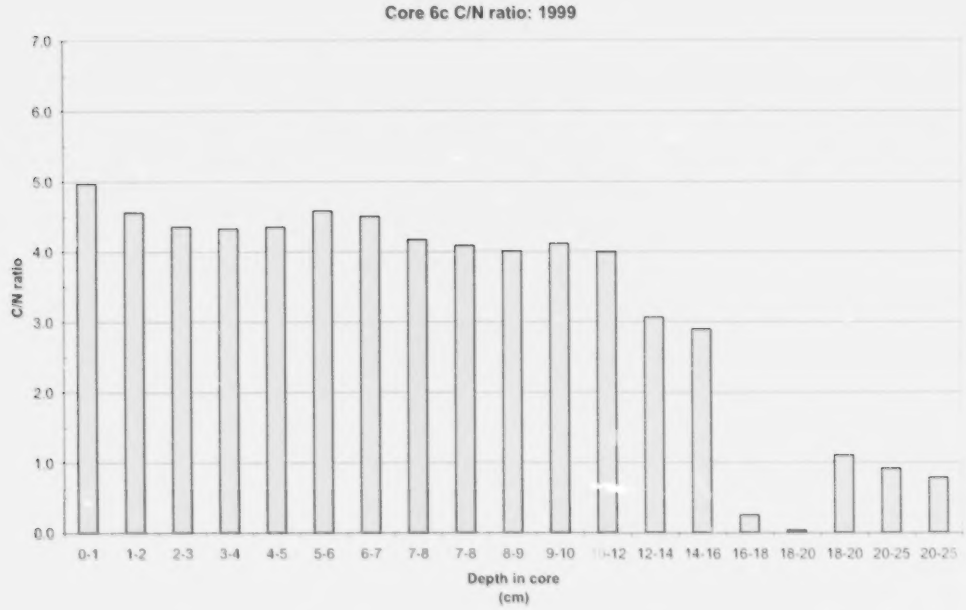


Figure 17. Viscount Melville Sound sediment: C/N ratio vs depth in core.

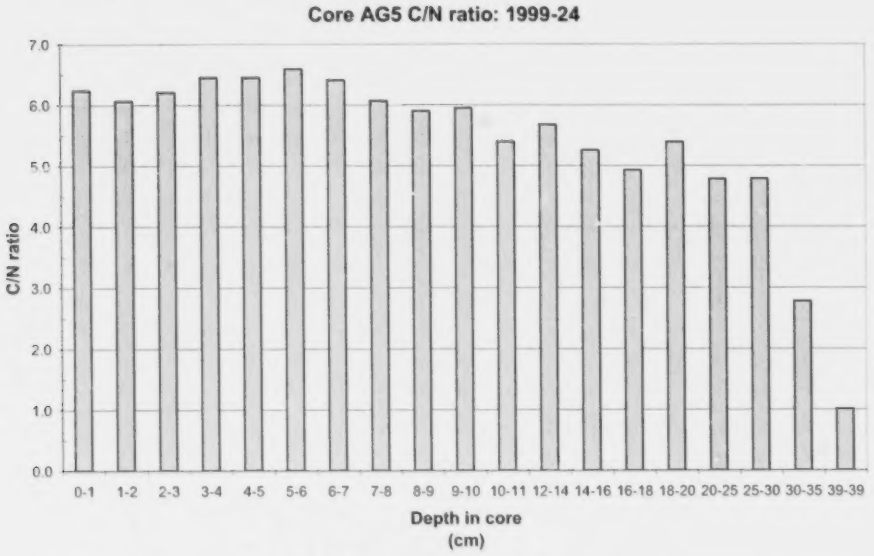


Figure 18. Amundsen Gulf sediment: C/N ratio vs depth in core.

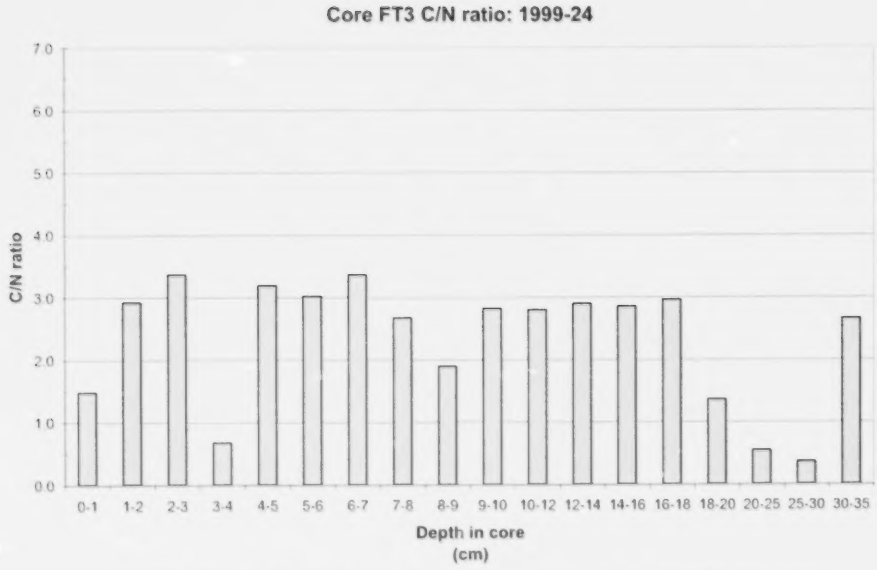


Figure 19. Peel Sound sediment: C/N ratio vs depth in core.

Table 18. Mission 1999-24 sediment core sample moisture content.

Sample ID	Depth (cm)	Wet sediment (g)	Dry sediment (g)	Moisture content
7a	0-1	3.21647	1.99059	0.3811
7a	1-2	4.49441	2.89666	0.3555
7a	2-3	3.99757	2.65649	0.3355
7a	3-4	4.37483	3.17586	0.2741
7a	4-5	5.18103	4.01046	0.2259
7a	5-6	4.76555	3.76046	0.2109
7a	6-7	5.47816	4.40478	0.1959
7a	7-8	5.43406	4.42015	0.1866
7a	8-9	4.45111	3.63411	0.1835
7a	8-9	3.62337	2.97589	0.1787
7a	9-10	3.91396	3.20428	0.1813
7a	10-12	4.61878	3.76987	0.1838
7a	12-14	4.33825	3.58335	0.1740
7a	12-14	3.67851	3.04078	0.1734
7a	14-16	3.67314	3.04123	0.1720
7a	16-18	4.00220	3.30011	0.1754
7a	18-19.5	3.97383	3.32309	0.1638
6c	0-1	3.29698	1.82692	0.4459
6c	1-2	3.30192	1.77974	0.4610
6c	2-3	3.64165	1.95555	0.4630
6c	3-4	3.24647	1.76351	0.4568
6c	4-5	3.48057	1.91923	0.4486
6c	5-6	3.62397	2.05994	0.4316
6c	6-7	2.99113	1.74836	0.4155
6c	7-8	2.99354	1.77312	0.4077
6c	7-8	3.85050	2.28659	0.4062
6c	8-9	2.88969	1.76814	0.3881
6c	9-10	2.97230	1.83928	0.3812
6c	10-12	3.49596	2.25840	0.3540
6c	12-14	3.70557	2.68424	0.2756
6c	14-16	3.55915	2.65605	0.2537
6c	16-18	4.00709	3.17380	0.2080
6c	18-20	5.03134	4.15890	0.1734
6c	18-20	3.65053	3.06704	0.1598
6c	20-25	4.83533	3.94324	0.1845
6c	20-25	3.65901	2.89691	0.2083

(Cont'd) Mission 1999-24 sediment core sample moisture content.

Sample ID	Depth (cm)	Wet sediment (g)	Dry sediment (g)	Moisture content
AG-5	0-1	3.50600	1.49348	0.5740
AG-5	1-2	3.97938	1.73562	0.5638
AG-5	2-3	3.66372	1.62502	0.5565
AG-5	3-4	2.90189	1.33978	0.5383
AG-5	4-5	3.36263	1.58366	0.5290
AG-5	5-6	3.86187	1.85339	0.5201
AG-5	6-7	3.20460	1.59515	0.5022
AG-5	7-8	4.07380	2.05460	0.4957
AG-5	8-9	3.42704	1.76011	0.4864
AG-5	9-10	4.74417	2.48291	0.4766
AG-5	10-11	4.58551	2.40317	0.4759
AG-5	12-14	4.73684	2.64248	0.4421
AG-5	14-16	5.25864	3.02083	0.4255
AG-5	16-18	4.88423	2.82337	0.4219
AG-5	18-20	4.01763	2.30791	0.4256
AG-5	20-25	4.46918	2.59368	0.4197
AG-5	25-30	4.46918	3.19866	0.2843
AG-5	30-35	5.20816	3.73887	0.2821
AG-5	35-39	4.12706	3.25190	0.2121
Duplicates				
AG-5	7-8	3.44313	1.77278	0.4851
AG-5	16-18	3.63271	2.09972	0.4220
AG-5	35-39	4.86434	3.06080	0.3708
FT-3	0-1	2.17143	1.30540	0.3988
FT-3	1-2	2.13927	1.29495	0.3947
FT-3	2-3	2.57073	1.56104	0.3928
FT-3	3-4	3.13233	1.92090	0.3868
FT-3	4-5	3.75870	2.37418	0.3684
FT-3	5-6	3.01838	1.97027	0.3472
FT-3	6-7	3.58331	2.34761	0.3448
FT-3	7-8	2.73174	1.73891	0.3634
FT-3	8-9	3.93070	2.46593	0.3726
FT-3	9-10	2.28440	1.43315	0.3726
FT-3	10-11	2.48268	1.55785	0.3725
FT-3	12-14	3.68200	2.35396	0.3607
FT-3	14-16	3.51442	2.26222	0.3563
FT-3	16-18	2.38704	1.60801	0.3264
FT-3	18-20	2.64640	1.66533	0.3707
FT-3	20-25	2.55023	1.62500	0.3628
FT-3	25-30	2.28491	1.49537	0.3455
FT-3	30-35	3.44888	2.38932	0.3072
Duplicates				
FT-3	6-7	3.27236	2.08988	0.3614
FT-3	16-18	2.17114	1.40301	0.3538
FT-3	30-35	3.10088	2.15085	0.3064

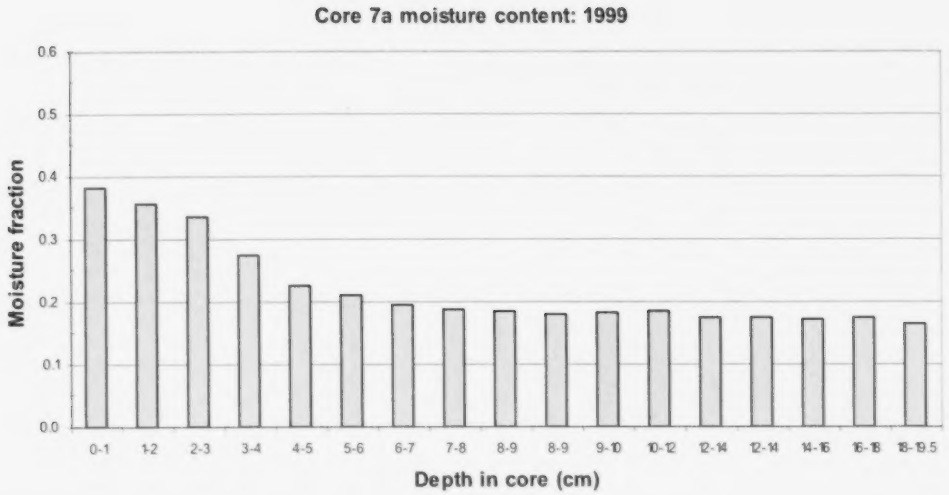


Figure 20. Viscount Melville Sound sediment: moisture fraction vs depth in core.

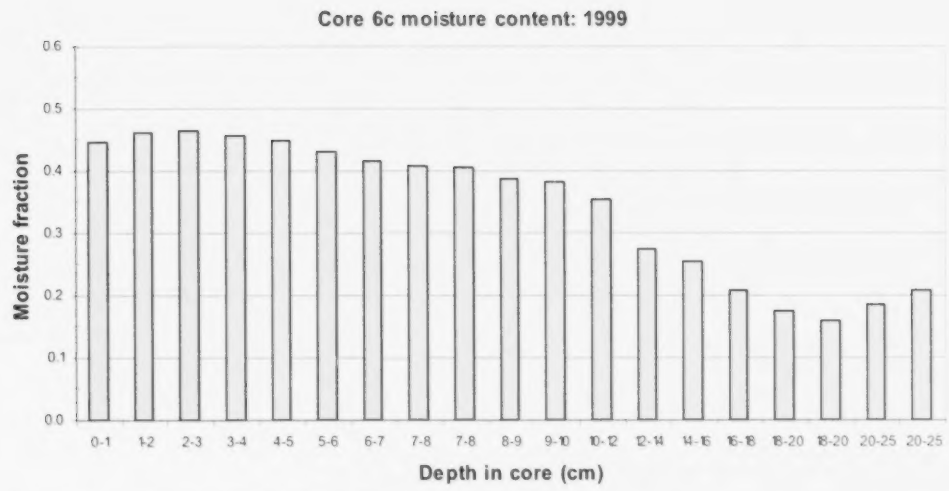


Figure 21. Viscount Melville Sound sediment: moisture fraction vs depth in core.

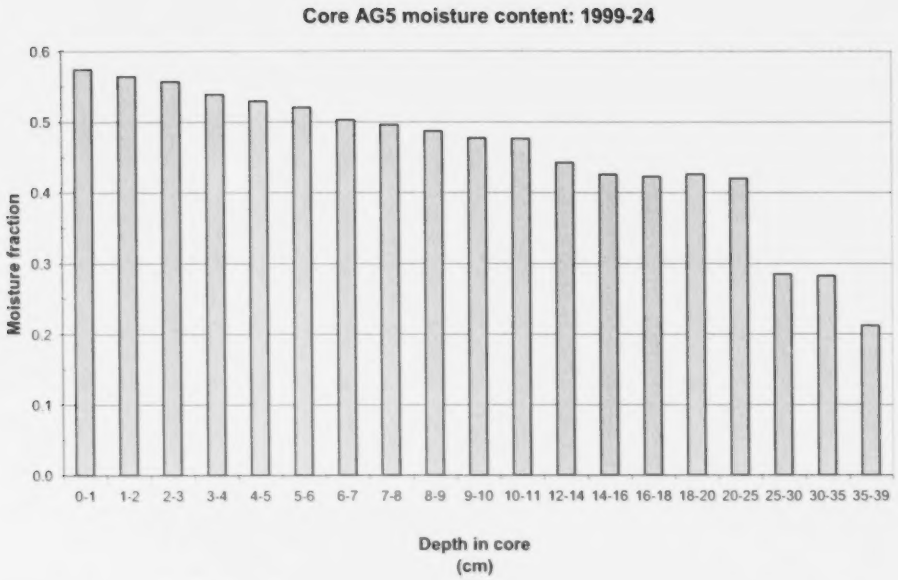


Figure 22. Amundsen Gulf sediment: moisture fraction vs depth in core.

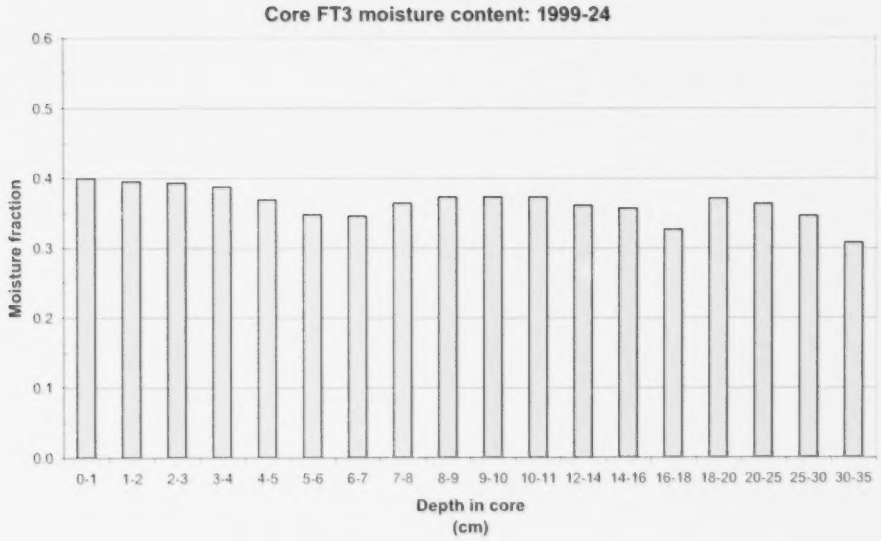


Figure 23. Peel Sound sediment: moisture fraction vs depth in core.

5. RELATED DATA REPORTS IN THE CANADIAN DATA REPORT OF HYDROGRAPHY AND OCEAN SCIENCES SERIES

Carmack, E., Papadakis, J.E., Macdonald, D.M. and Macdonald, R.W. 1989. NOGAP B.6. Physical data collected in the Beaufort Sea, summer, 1987. *Can. Data Rep. Hydrogr. Ocean Sci.* 60(6): 219 p.

Cuypers, L.E., Blaskovich, A.W., Carmack, E.C. and Macdonald, R.W. 1988. NOGAP B.6. Physical data collected in the Beaufort Sea, September, 1986. *Can. Data Rep. Hydrogr. Ocean Sci.* 59: 149 p.

Macdonald, R.W., Carmack, E.C., McLaughlin, F.A., Sieberg, D., O'Brian, M.C., Paton, D., Pearson, R., Liangfeng, Y. and Gobeil, C. 1991. Oceanographic data collected from the *Henry Larsen* in the Beaufort Sea, August-September 1990. *Can. Data Rep. Hydrogr. Ocean Sci.* 97: 142 p.

Macdonald, R.W., Carmack, E.C., O'Brien, M.C., McLaughlin, F.A., Minkley, B.G. and Berger-North, K. 1990. Oceanographic data collected from the Sir John Franklin in the Beaufort Sea, September 1989. *Can. Data Rep. Hydrogr. Ocean Sci.* 80: 100 p.

Macdonald, D.M., Cuypers, L.E., McCullough, D., Carmack, E. and Macdonald, R.W. 1988. NOGAP B.6. Physical data collected in the Beaufort Sea, March-June 1987. *Can. Data Rep. Hydrogr. Ocean Sci.* 60(2): 157 p.

Macdonald, R.W., Iseki, K., Carmack, E.C., Macdonald, D.M., O'Brien, M.C. and McLaughlin, F.A. 1988. NOGAP B.6. Beaufort Sea Oceanography, September, 1986. *Can. Data Rep. Hydrogr. Ocean Sci.* 58: 68 p.

Macdonald, R.W., Iseki, K., O'Brien, M.C., McLaughlin, F.A., McCullough, D., Macdonald, D.M., Carmack, E.C., Adams, H., Yunker, M., Miskulin, G. and Buckingham, S. 1988. NOGAP B.6. Chemical data collected in the Beaufort Sea, Summer 1987. *Can. Data Rep. Hydrogr. Ocean Sci.* 60(4): 103 p.

Macdonald, R.W., Iseki, K., O'Brien, M.C., McLaughlin, F.A., McCullough, D., Macdonald, D.M., Carmack, E.C., Yunker, M., Buckingham, S. and Miskulin, G. 1988. NOGAP B.6. Chemical data collected in the Beaufort Sea, and Mackenzie River delta, March-July 1987. *Can. Data Rep. Hydrogr. Ocean Sci.* 60(5): 55 p.

Macdonald, R.W., O'Brien, M., Carmack, E.C., Pearson, R., McLaughlin, F.A., Sieberg, D., Barwell-Clarke, J., Paton, D.W. and Tuele, D. 1995. Physical and chemical data collected in the Beaufort, Chukchi and east Siberian seas, August-September 1993. *Can. Data Rep. Hydrogr. Ocean Sci.* 139: 287 p.

Macdonald, R.W., Pearson, R., Sieberg, D., McLaughlin, F.A., O'Brien, M.C. Paton, D.W., Carmack, E.C., Forbes, J.R. and Barwell-Clarke, J. 1992. NOGAP B.6. Physical and chemical data collected in the Beaufort Sea and Mackenzie River delta, April-May 1991. *Can. Data Rep. Hydrogr. Ocean Sci.* 104: 154 p.

Macdonald, R.W., Sieberg, D., Pearson, R., Paton, M., O'Brien, M.C., McLaughlin, F.A. and Carmack, E.C. 1992. Oceanographic data collected from the *Henry Larsen* in the Beaufort Sea, September 1991. *Can. Data Rep. Hydrogr. Ocean Sci.* 112: 108 p.

McLaughlin, F., Carmack, E., O'Brien, M., Adamson, L., Barwell-Clarke, J., Gatien, G., Hingston, M., Johnston, P., May, B., Melling, H., Poliquin, M., Riedel, D., Sieberg, D., Tuele, D., VanHardenberg, B., Walsh, D., Welch, B., and Welch, C. 2008. Physical and chemical data from the Canadian Arctic Archipelago, August 28 to September 18, 1997. *Can. Data Rep. Hydrogr. Ocean. Sci.* 176: vi + 140 p.

McLaughlin, F., Carmack, E.C., Zimmermann. S., Sieberg, D., White, L., Barwell-Clarke, J., Steel, M. and Li, W.K.W. 2008. Physical and chemical data from the Canada Basin, August 2004. *Can. Data Rep. Hydrogr. Ocean. Sci.* 140: vi + 185 p.

Pearson, R., C'Brien, M., Sieberg, D., McLaughlin, F.A., Paton, D.W., Tuele, D., Barwell-Clarke, J., Carmack, E.C., Macdonald, R.W. and Galbraith, M. 1994. NOGAP B.6. Physical and chemical data collected in the Beaufort Sea and Mackenzie River delta, April-May and September, 1992, and ice core data collected in 1991-1992. *Can. Data Rep. Hydrogr. Ocean Sci.* 129: 199 p.